# Municipal and County Engineering

**DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS**

Vol. LVI. JUNE, 1919. No. 6

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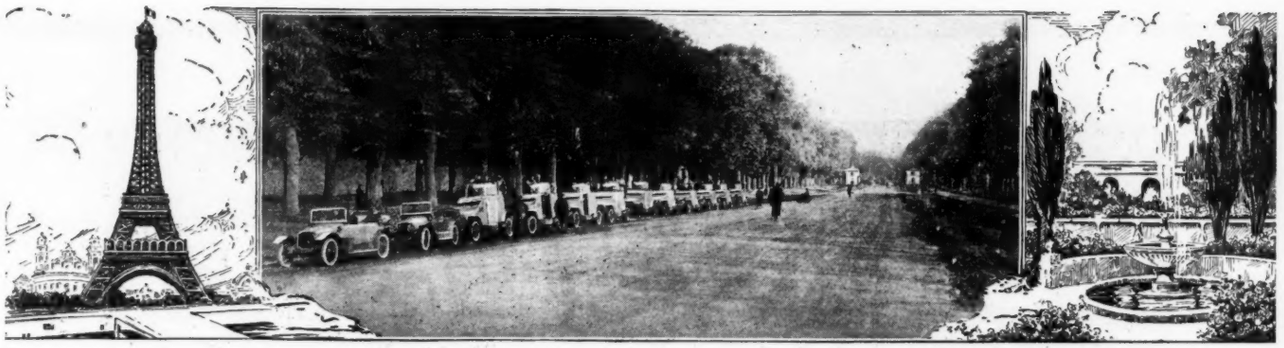

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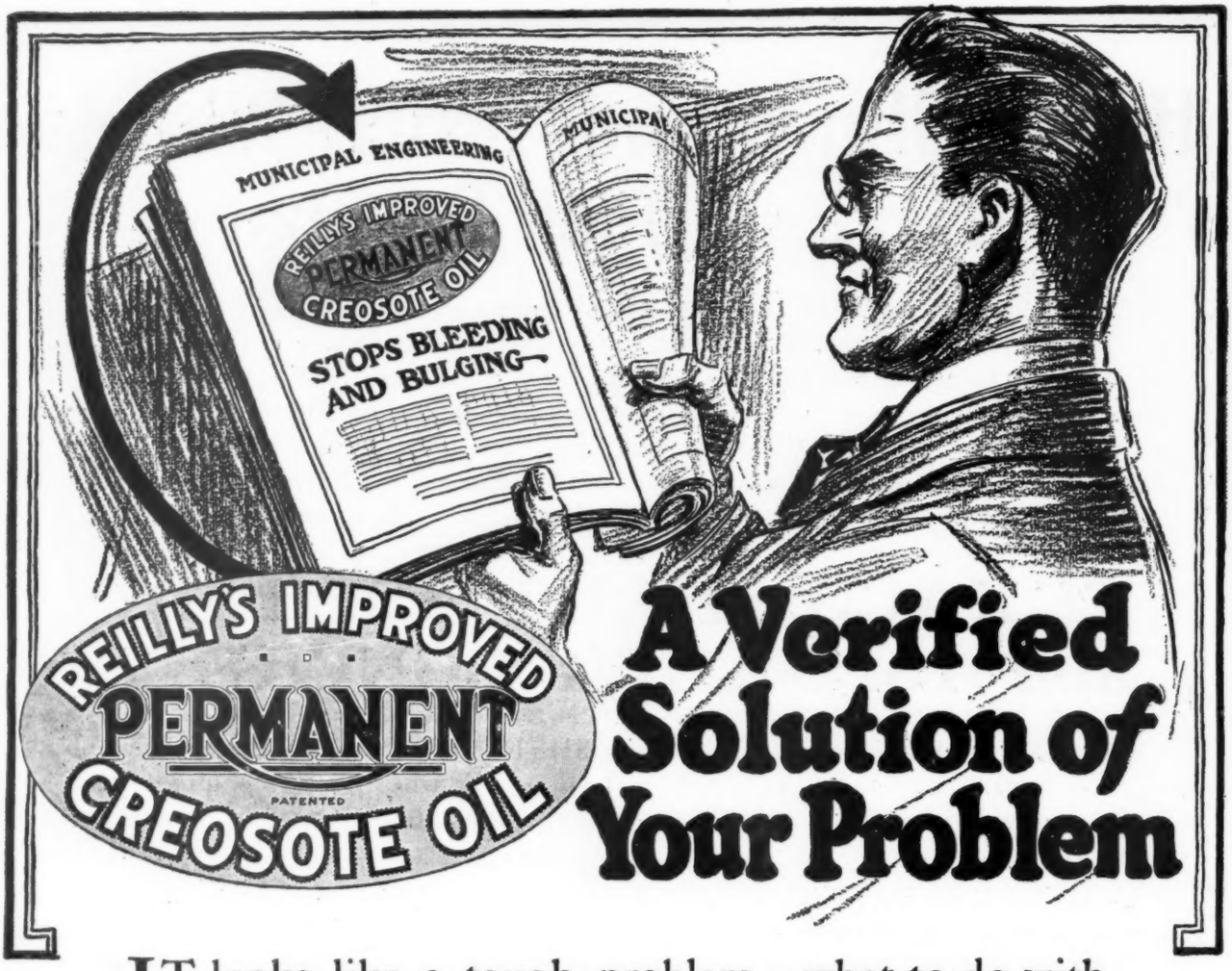


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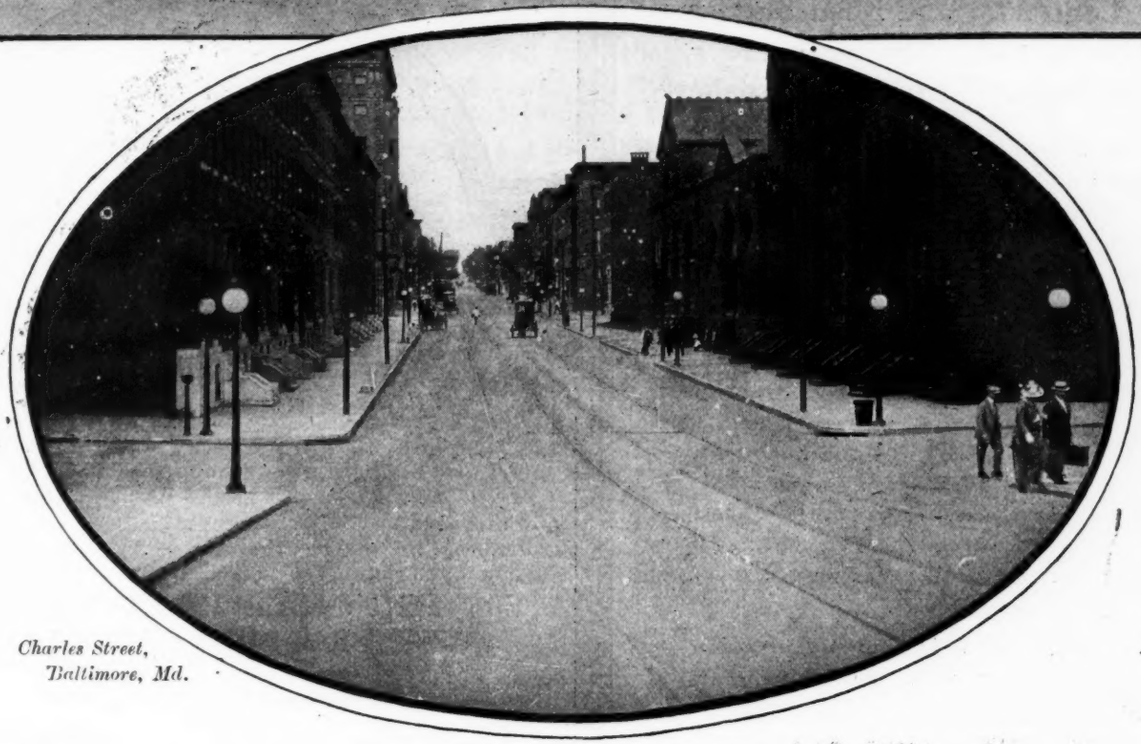

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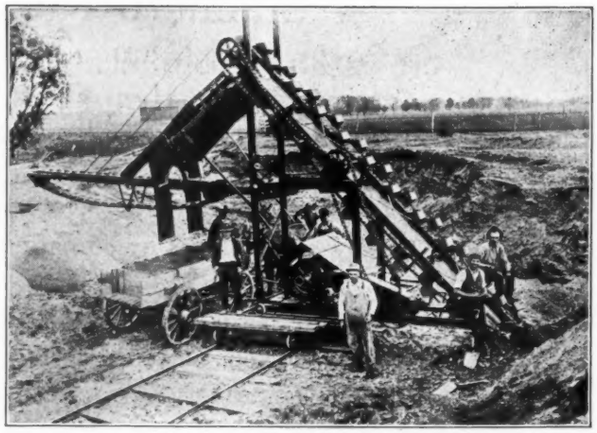

**Calhoun County (Michigan) owns and operates four of these machines, and contractors own three others, making seven in the County.**

*For further particulars write to*

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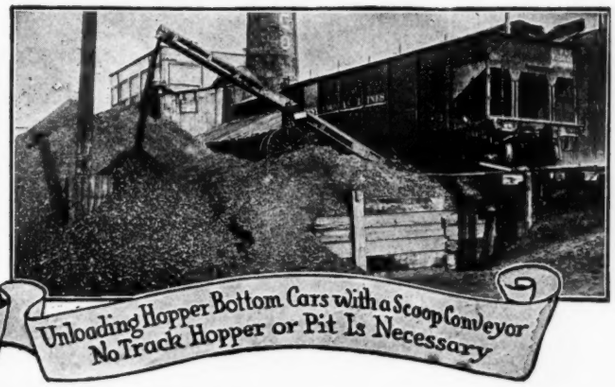

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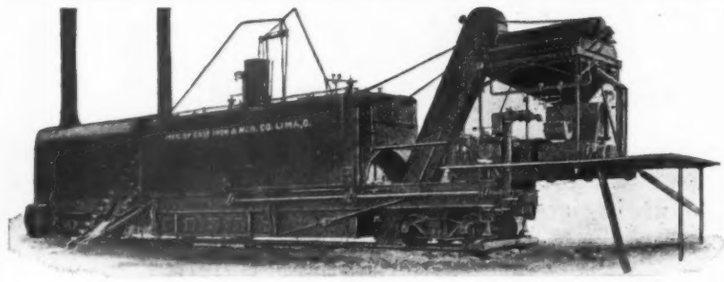

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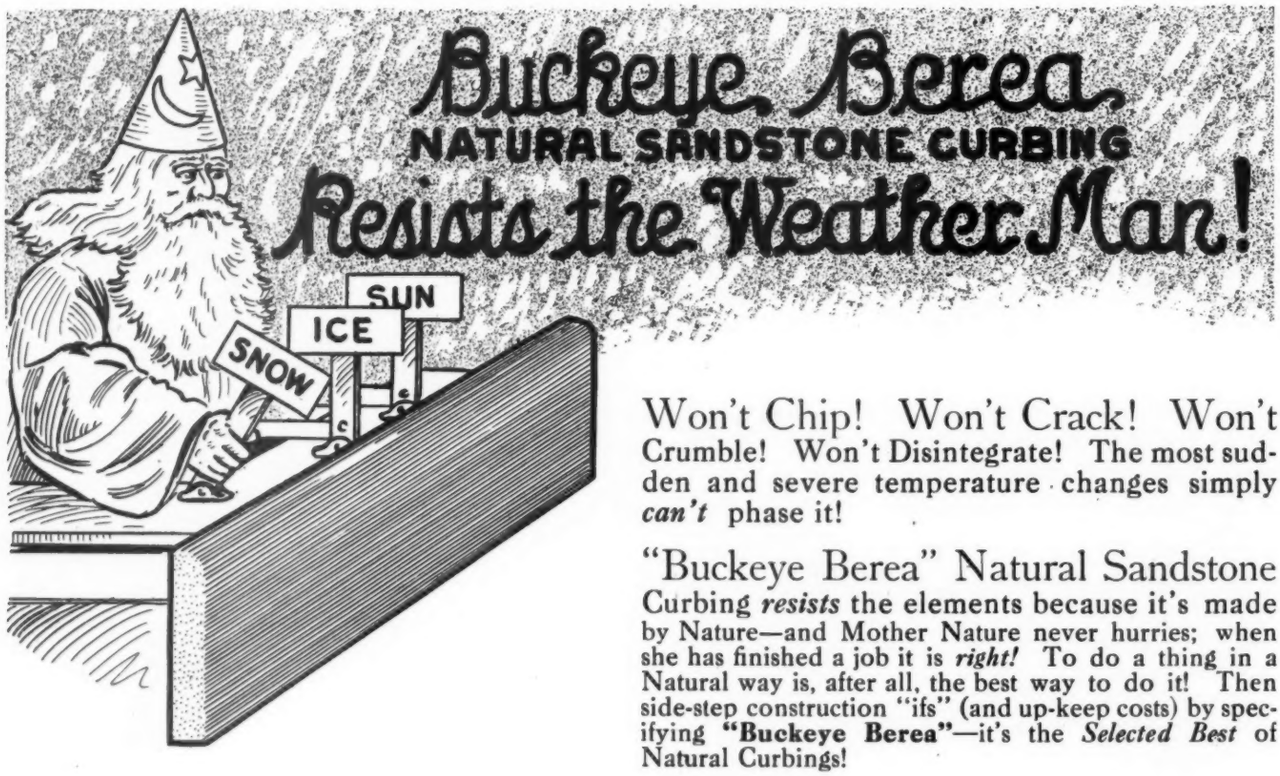


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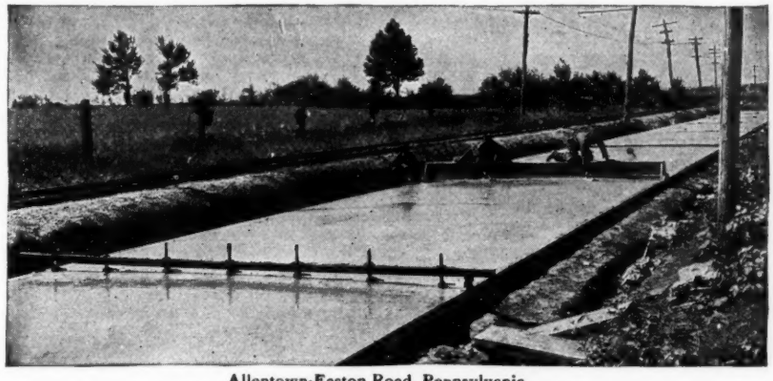

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**Flue Liners.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis

**Forms, Sidewalks, Curb & Gutter.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Forms, Road.**
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Truscon Steel Co.

**Forms (Sewers & Conduits).**
Heltzel Steel Form & Iron Co.

**Forms (Wall Bldg., Construction, Etc.).**
Heltzel Steel Form & Iron Co.

**Gas Pipe.**
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

**Graders.**
Austin-Western Road Machinery Co., The

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Koehring Machine Co.

**Graders, Turbine.**
Koehring Machine Co.

**Gravel Screener and Loader.**
The Jordan & Steele Mfg. Co., Inc.

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Littleford Bros.

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Littleford Bros.

**Hoists (Concrete, Gasoline and Hand).**
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Bell Locomotive Works, Inc.

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Ford Meter Box Co., The

## Speed Up Your Grading Job

**A cubic yard a minute.** That's the record of Baker-Maney Self Loading Scrapers. Seven years of moving dirt has proven them to be the all-round excavator. The large capacity—one cubic yard—the speed of loading—low operating cost and freedom from delays make a combination that means cheap, quick dirt moving.

The "MANEYS" **save 25 to 50 per cent** over two-wheelers. They move dirt cheaper than big excavators on hauls of 200 to 2,000 feet. No skilled labor is required to operate them. A good tractor or a four-up team loads them and one team hauls them. They pull easier than dump wagons. They are the only direct method of moving dirt in quantity.

**BAKER** Maney Self-Loading Scrapers

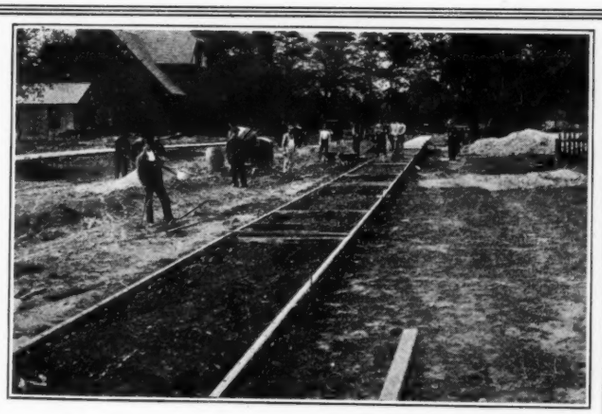
*Ask for Big Catalog*

**THE BAKER MANUFACTURING CO.**

**570 Stanford Ave. SPRINGFIELD, ILL.**

*Ask for Name of Nearest Distributor.*





## An Industrial Housing Project at Newport News

Is being put through with speed by the Mellon Stuart Co. for the Emergency Fleet Corp. by the use of

## HELTZEL Steel Forms

A combination of unit Rails which were used interchangeably was adopted for concrete sidewalks, curbs and gutters and concrete streets, thus reducing labor and time of costs to a minimum. Put your form requirements in the hands of experts. Uncle Sam's Engineers have always benefitted by our broad experience and accepted our recommendations.

***Let us reduce your form expenses by the results of our broad experience.***

**The Heltzel Steel Form & Iron Co.**

**WARREN, OHIO**

## Speed Up Gravel Production

**Maximum development of the country's resources of natural road building material is essential to the rapid completion of the vast mileage of good roads for which hundreds of millions of dollars have been appropriated by the government and the various states.**

**The production of gravel to meet the huge demands of the road builders is, first of all, an excavating problem.**

## SAUERMAN DRAGLINE CABLEWAY EXCAVATORS

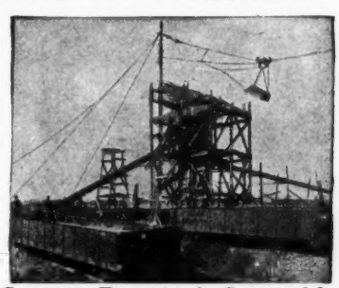
**are machines of superior merit for excavating sand and gravel.**

**No other type of machine possesses the ability to cover an area of 500 ft. radius and dig, convey, elevate and dump material in one continuous operation without help of intermediate machinery.**

**No other type of excavator can excavate gravel from a stream or pool and convey to bins, hopper or cars. Sauerman Dragline Cableway Excavators are as efficient in digging under water as in a dry pit.**

**Sauerman outfits are economical to operate. One man at the levers of a two-drum hoist controls all the operations of digging, conveying, elevating and dumping. After dumping, the bucket returns to the digging point by gravity.**

**The experience of our engineers in installing our cableway excavators for hundreds of sand and gravel producers and contractors is at your service if you have a gravel deposit to develop or any similar excavating problem. Write us today.**



**Sauerman Excavator in Commercial Sand and Gravel Plant**

**Road Contractor's Plant Using One of Our Machines**

**Bucket Can Be Dumped at Any Desired Point on Cableway**

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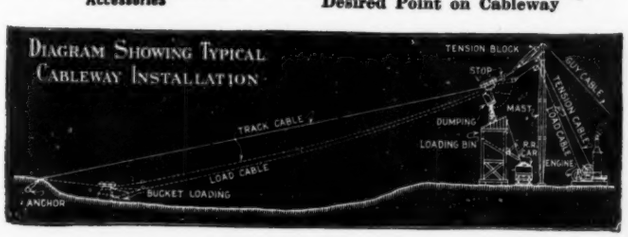
1142 Monadnock Block
**Chicago**

**Mnfrs. of Cableway Excavators Power Scrapers and Cableway Accessories**



# BUYERS' GUIDE

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Littleford Bros.

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Kirschbraun, Lester
Van Trump, Isaac.

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Pennsylvania Salt Mfg. Co.

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Springfield Paving Brick Co.

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Barrett Co., The
DuPont Chemical Co.
Republic Creosoting Co.

# MOTOR TRUCKS

*Motor Trucks as Operated in Municipal and County Service and in Highway Transportation*

## Adaptable For Municipal Work

The short wheelbased Autocar easily gets in and out of places where motor truck operation would seem impossible. It is quick and handy and can turn around without backing in the average city street.

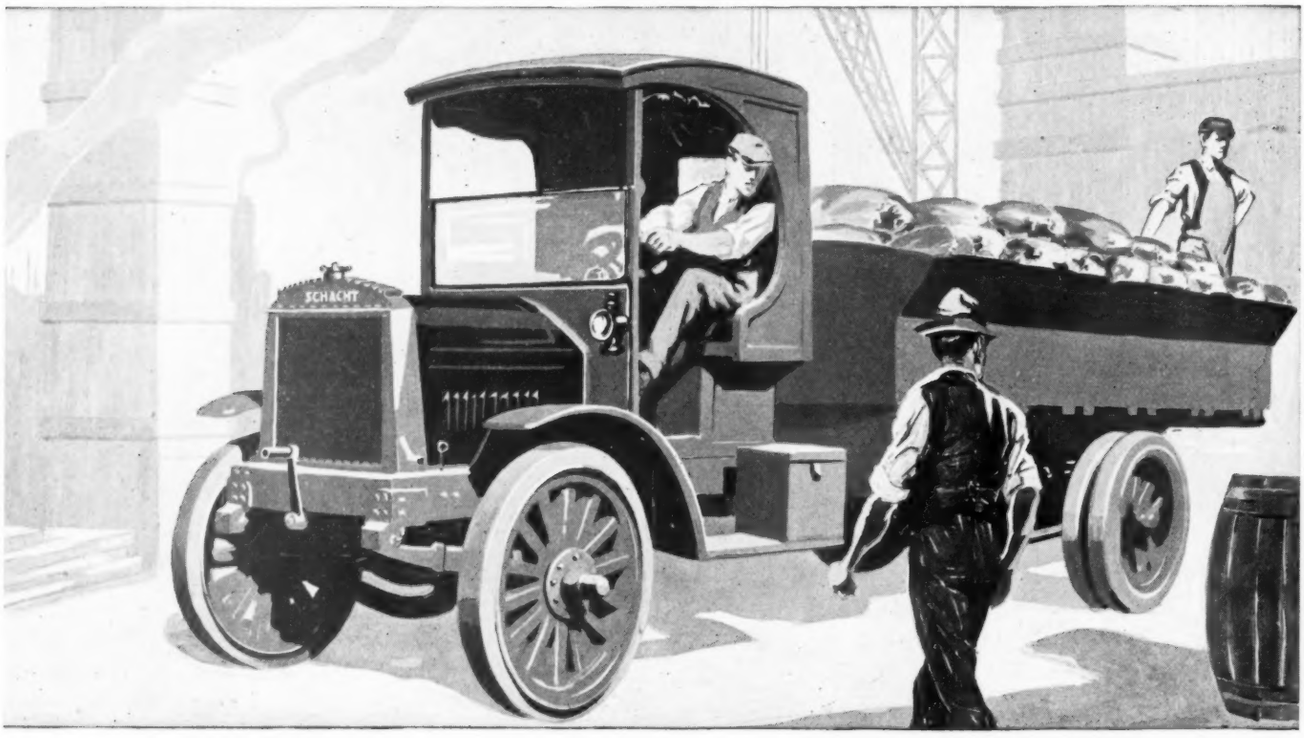
With the Autocar, every load—large or small—is an economical load. Its balanced design and sturdy construction permit of a larger load in proportion to its weight. Less power is required to move the truck, and more power remains for useful work.

**Chassis $2050**
**97 inch wheelbase**

**THE AUTOCAR COMPANY**
**Ardmore, Pa.** **Established 1897**

# Autocar

Printed as insert to Municipal and County Engineering, Chicago, June, 1919.




# A Big Field for Good Dealers

SCHACHT Trucks are designed and manufactured all in one plant—they are not assembled trucks. They are built for heavy work, to meet the conditions of a steady grind of heavy hauling under heavy loads.

For eleven years Schacht Trucks have made good for contractors—made good in low maintenance and repair expense. They haul building materials at the lowest cost per ton mile.

They are powerful, strongly built of the best possible materials. The design is simple, clean; men who know trucks like Schacht Trucks on sight. Equipped with dump bodies, they make the ideal truck for the contractor.

Schacht Trucks build good-will and bring repeat orders wherever they are used. The Schacht is a most profitable addition to the line of the dealer in contractor's machinery. They are good looking, they demonstrate well, and they make good in service.

Here is a big opportunity for live dealers.

## The G. A. Schacht Motor Truck Company

**Eighth and Evans Streets** **CINCINNATI, OHIO.**

# Schacht WORM DRIVE Motor Trucks

THE PICTURE SHOWS THAT

# A MUD ROAD DOES NOT STALL

## Wilson *Dependable Motor Trucks*

Contractors, if you think the mud roads you are often forced to use in hauling construction materials and equipment would put a truck out of business, just look at this picture. If you think that trucks are all right on city pavements but doubt their practicability on the bad roads of the country, look at the picture again. Did you ever see a muddier road than this one?

The picture shows a two-ton **Wilson** carrying a one-tonner on a piece of road between Unity, Ohio, and Beaver Falls, Pennsylvania, which is celebrated as one of the abiding places of mud, that "daughter of the devil—that offering of evil." The picture shows the best part of the unimproved 15-mile stretch.

## NOTHING STALLS A WILSON

A Pittsburgh, Pa., concern recently **investigated** twenty-two makes of trucks and chose the ***Wilson.*** They decided to learn of the performance of ***Wilson*** trucks from ***Wilson*** users. Here are some of the specific pieces of information they secured:

"One fleet of 24 ***Wilson*** trucks with a running average in 18 months of over 21,600 miles each, showed a service repair and labor cost of only $2.05 per truck per month. Now bear in mind, this covered **all** repair parts and labor necessary to keep the trucks in good running order. No other truck that we investigated could show a service performance so astonishingly low over such a long period.

"We went further; and here is what another user told us:

'Yesterday we purchased our fourth ***Wilson*** truck. The first ***Wilson*** we bought (March, 1915) is apparently as good as new and still covers from 90 to 110 miles a day, with **96,000 miles already to its credit.** In repair parts and labor expense this truck has cost us only $3.47 per month.'

***"Wilson*** trucks are being used by the United States Government. So we went to the Government and found that 150 two-ton trucks, in operation for a total of 600 months, showed an average monthly repair cost of **only 55 cents per truck.**

"Scores of other ***Wilson*** users spoke highly of ***Wilson*** trucks. But what impressed us most was the fact that everywhere and every place we went ***Wilson*** users were **buying additional *Wilson* trucks."**

## J. C. WILSON COMPANY—36th Year

**Export Office, 100 Broad St., New York.** **DETROIT, U. S. A.**

**LONDON – PARIS**

**1, 2, 3½ and 5 ton—All Worm Drive.** ***A Model for Every Municipal and County need.***

# MOTOR TRUCK OPERATION AND ACCOUNTING XLVI

*Successful Truck Distributors Offer Helpful Suggestions and Data on Use of Trucks in the Public Works Field*

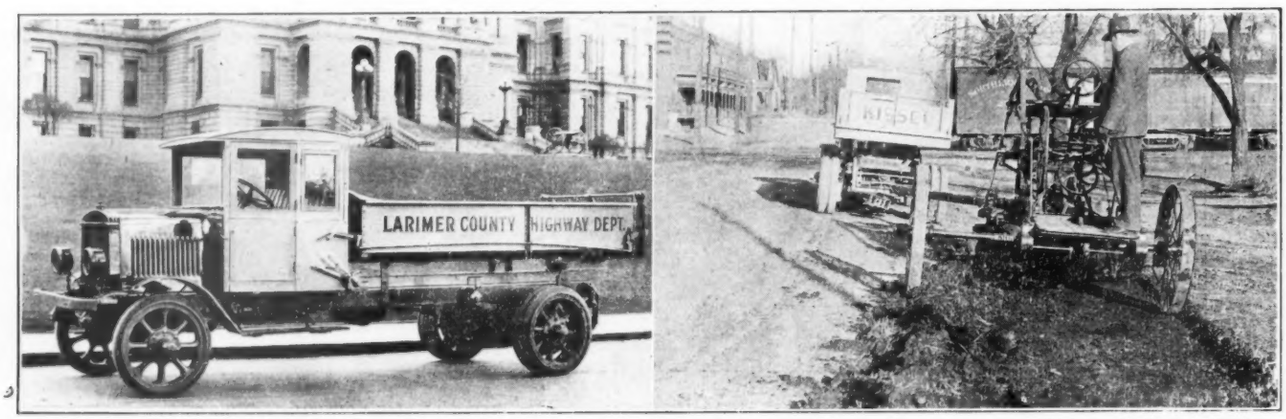
The following observations on the sale and use of motor trucks on public works construction and maintenance can be read with profit alike by truck seller and truck buyer. This most interesting statement was prepared for publication in this motor truck section of Municipal and County Engineering by The Miller-Ray Motor Co., of Denver, Colo., distributor of Kissel Cars and Trucks in Colorado, Wyoming and New Mexico. The statement follows:

"In the sale of trucks for road maintenance work to the different counties throughout our territory, although we have been very successful in this connection and the county commissioners and municipal authorities have been very much pleased with the results obtained, we believe there would be a greater number of trucks used by these people if the various houses who undertake the sale of trucks for this purpose would deal in plain cold facts instead of making broad assertions that cannot be proven when the prospective purchasers call for demonstrations under the conditions which these trucks necessarily have to work.

"We believe that if any motor truck salesman attempting to sell his product to a county would read the various engineering publications and thereby familiarize himself with the conditions and requirements that are to be met, he would be in position to go out and deal with the county commissioners and municipal authorities in such a way that the purchase of trucks would be more satisfactory than where the salesman does not know the field.

"The writer once had a deal on in a certain county, in our territory, that had not previously thought of trucks for use in road maintenance work. After going to the Court House and giving the commissioners a talk he was told that one salesman could do this and the other salesman another thing, and the commissioners repeated a dozen other assertions that the various salesmen made in connection with the use of their trucks in this kind of work which were physical impossibilities. The writer had the pleasure of standing "pat" on the very conservative statements and figures presented to these gentlemen and, consequently, when there was an advertisement for bids and a date was set for competitive demonstrations, he was able to prove that these other assertions were fallacious. If the writer had made some broad statements which couldn't be backed up when this competitive demonstration was held, there would not have been a sale of trucks to this county and they would have been using horses at this time.

"We do not try to sell a truck and convince anybody that it will do the impossible. If it is necessary for us to go down into a gravel pit, it might be possible for us to come out with a full load but even should that be the case, we figure it is not an advisable thing to recommend to a county. We, however, do recommend some provision to go into the pit which enables the driver to put on the load and come out again with ease, thereby eliminating all undue stress on the truck and at the same time decreasing repairs to the minimum over a period of years. It is easy for any commissioner to procure a number of old cross ties that have been discarded by a railroad and by placing these, say, 4 ft. apart, shaping up a bed for them to set on and nailing heavy planks across with cleats about 1 ft. apart on top and making sections about 16 ft. long, the operator can prepare a drive-way right down into the gravel pit at very little cost. He can then back his truck down over a track of this sort and be able at all times and under all weather conditions to secure a traction that will permit him to pull out and to do it with ease. We believe that if any highway supervisor would resort to this method even though he is fairly successful otherwise, it would prove very advantageous to him if for only one purpose and that to protect the truck against unnecessary wear and tear.




KISSEL 3½-TON MOTOR TRUCK AS OPERATED BY THE HIGHWAY DEPARTMENT OF LARIMER COUNTY, COLO.

"It is not advisable to use a truck to pull unusually large graders or such other equipment as is required in making new road beds for the simple reason that there is not sufficient traction to accomplish what is wanted. Tractors and teams can be rented from the farmers throughout the various communities for this purpose, and after the road bed preparations are made by employing tractors or teams the surfacing materials can be hauled, dumped and spread by motor truck at a figure equivalent to about one-fourth of what it would cost with teams.

"We have found that a 3½-ton truck with a 3½ cu. yd. body and hydraulic hoist is capable of transporting 4 yds. of gravel a distance of four miles, dumping and spreading this material 5 ins. deep for a length of 90 ft. and a width of 6 ft. in seventeen minutes. The writer, at one time, followed up a truck that accomplished this and feels certain that it would have taken a good part of a half day for any driver using a team to accomplish this same thing.

"One man drove the truck from the gravel pit and when he

# Built by Service —Backed by service

Among other pertinent reasons why SERVICE Motor Trucks should be your choice is that you will receive unusually attentive and efficient service in the maintenance of the trucks.

Acceptance of the SERVICE franchise by any dealer provides a guarantee that he will render to his customers service station assistance second to none.

Expert aid to users has much to do with the excellent and enviable SERVICE records of performance, endurance and economy.

*Complete Catalog on request.*

**Service Motor Truck Co.**
Wabash, Indiana, U. S. A.
*Distributors in All Principal Cities.*

NEW YORK
87-89 West End Ave.

CHICAGO
2617-25 So. Wabash Ave.

SERVICE Motor Trucks are built in sizes to meet every hauling requirement. All models have the incomparable worm drive—the drive that has never worn out in use.

*SERVICE Motor Trucks on the Job at the New Union Depot Chicago*

came to the point where the material was to be used, he merely elevated his hydraulic hoist and drove the truck down the road spreading the material as mentioned above in approximately two minutes. A man with a team using a bottom lump body would be obliged to dump his material all in one place and it would require the labor of five to six men for about thirty minutes to spread this material as a truck would spread it and even then it would be very hard for them to do the same as evenly as it would be done with a truck in such a short length of time. We think that this instance, as well as a number of others here given should convince any highway worker that a truck is the advisable thing to use even though it is sometimes necessary to employ other equipment for special work.

"There are a number of counties buying road surfacing materials at very high figures where it is possible to procure them in the immediate vicinity where the material is needed. The writer went into Larimer County, Colorado, and found the commissioners having their material shipped in at a cost of $1.35 per cu. yd. f. o. b. Fort Collins, Colo. It was then necessary for them to transport this material a distance of about ten miles to a point where they intended doing five miles of resurfacing. The writer, in going over the roads with the commissioners with the idea of giving them an approximate cost of transporting this material by trucks, found that in a corner of a farm right near the surface of the ground there could be obtained a road surfacing material that was superior to that for which this county was paying $1.35 per yard. The writer made the suggestion that they purchase three acres of this ground adjoining the road and use the material that could be found there for resurfacing instead of purchasing other material, thereby securing the double advantage of having a gravel pit right at the point where they were working and making it unnecessary for them to delay operations on their road work, while awaiting shipments by railroad. This appealed to them very much and when they mentioned it to the farmer owning the land he gladly donated these three acres of ground to the county for the purpose of providing the road material necessary to resurface the amount of roads that they had contemplated and, consequently this work was done for an amount considerably less than they had figured it would cost them had they employed their old equipment and bought their gravel at a distance. In fact, they were practically able to pay for two trucks from the saving in labor, the cost of material and such other incidentals necessarily involved by employing their old methods.

"We have a county in Colorado that has assigned 30 miles of road to one supervisor for maintenance, and this supervisor has furnished to him for his use, one 3½-ton truck, one wheel drag, one 9-ft. road grader, one plow, a truck driver and three laborers. This road, regardless of what month of the year you go over it, is always in the pink of condition, properly crowned, side ditches and everything in A-1 condition, due to the fact that they are able to keep it crowned up and drained properly by the use of the above mentioned equipment and men. They are able to get over the road several times more per month than with horse-drawn equipment.

"If there happens to be frost coming out of the ground which makes bad ruts, it does not take very long to get 3½ or 4 yds, of resurfacing material, hitch on the road grader and drag and drive to the point where the road is bad, and then by employing a grader and attaching it to the road grader hitch that is provided (or which should be provided) on the back of the truck, grade down into these deep ruts, back up and dump the surfacing material that is on the truck, back up against and get the drag, smooth it over and the ruts are taken care of. If within a distance of from five to ten miles from the starting point, by using the truck driver and one or two other men this can be done in a matter of three or four hours.

"Trucks have proven their superiority over horse-drawn equipment in view of the above facts. Now, to make a comparison, it will require two horses to a dump wagon, from two to four horses to pull a grader and two more to pull the drag. It would require three drivers and one man steering the grader which would be four men. On a drive of say five miles it would take three to five hours to make it against a possible 20 to 30 minutes and an hour at the outside by using a truck. Then should it be necessary to come back for another load of material, the bigger part of a day would be consumed by using teams or only an additional hour with a truck.

"It is easy for anybody familiar with road work to appreciate the above comparisons and instances mentioned and in addition to this we will say that a 3½ ton truck equipped with a 3½ cu. yd. hydraulic hoist body is capable of performing the following tasks: of pulling a 9-ft. road drag 30 miles in 8 hours; of pulling a 7-ft. road grader for such work as shaping up and leveling off bad spots from 15 to 20 miles per day; for supplanting four to six wagons and teams hauling resurfacing materials, bridge materials and supplies and, in fact, for general utility purposes.

"We have no actual statistics showing the exact comparison of a truck costs against the number of horses and wagons required to do the same volume of work per day but can say that there is a general trend towards the purchase of trucks by the various counties and municipalities throughout our section of the country owing to the high cost of labor, harness and equipment and feed required for animals and the fact that the work can be done with more speed at the right season of the year for road work by using trucks instead of horses."

*Motor Transportation Over Good Roads to Lower the Cost of Living*

The steadily mounting cost of living, which, despite the cessation of the war several months ago, still reveals an upward tendency which many experts believe will be permanent, will eventually be solved to the benefit of all, by motor transport, according to Martin J. Pulcher, vice-president and general manager of the Federal Motor Truck Company.

"The farmer has just experienced a period of comparative prosperity," he says. "He is never going to return to the old days and the old way. His mode of living is on a higher plane—his costs have come up with everyone else's. The consumer must pay for this and a living profit—and most consumers are willing to do so unless the first profits be unreasonable or a big wastage charged to them.

"There is, however, a way to save waste and loss. That is direct marketing. Marketing conditions for food products of farms must be bettered. The marketing of farm products has for years been handled through middlemen whose profits have far exceeded those of the farmer, although the time and effort put forth by the middleman are not to be compared to the labor and time of the farmer.

"It is a case of getting together—not only of shortening the miles to market by building good roads and manufacturing motor trucks to travel over these roads with big loads of produce, although these are very important factors,—but the farmer and the market must be brought together with all the big profit making agencies between the two as far as possible eliminated.

*One Motor Truck Line Serves 12 Oregon Towns*

A motor truck line is now serving twelve towns and all intermediate farms within fifty-five miles of Portland, Oregon, in the Williamette River Valley. Captain Hugh B. Scott began the operation of light draft steamers on this river between Portland and Salem in the seventies. Last fall, Captain Scott's son, E. B. Scott began the operation of the first truck line. Three Federals are used, two 3½ tonners on regular runs each making one round trip every twenty-four hours and a two-tonner on pick-up and delivery work at Portland. Freight rates range from 30 cts. to 40 cts. per 100 lbs.

The night truck from Salem is always well loaded with milk, butter, eggs, poultry, veal, hogs and vegetables. The

# How Uninterrupted Transportation Came To Industrial America

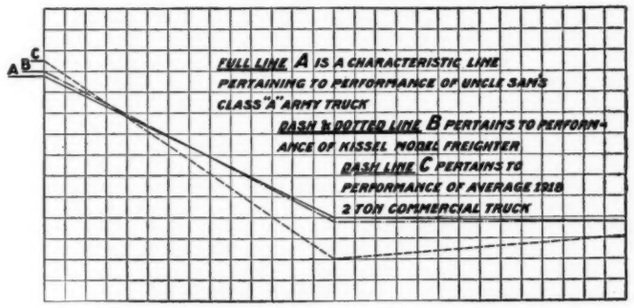
## By George A. Kissel

### What Uncle Sam Has Taught Us

"Saw a Kissel-built truck at the front and it's a bear," wrote a Kissel soldier boy with the American E. F. last Fall, and we here at the factory breathed a sigh of relief for up to that time we had wondered if the 24 hour pace we had maintained was giving results "Over There." For over a year we were a part of the most highly specialized and "efficiencyized" manufacturing organization that human ingenuity and money could perfect. Every man in our organization went through a most gruelling training course in his particular work—building to U. S. War Specifications—the most minute, strict and accurate measurements in the world. This "toeing the mark" under a veritable military regime made different men of us—we became experts—a highly specialized organization—

And then November 11th dawned—the armistice was signed—the war was over!

Since that day we have been gradually getting back to peace-time work—and it is with the same spirit of enthusiasm, knowledge and co-operation that characterized our "Building to U. S. War Specifications" that we now are "Building to U. S. Re-adjustment Specifications."


A B C
FULL LINE A IS A CHARACTERISTIC LINE
PERTAINING TO PERFORMANCE OF UNCLE SAM'S
CLASS "A" ARMY TRUCK
DASH & DOTTED LINE B PERTAINS TO PERFORM-
ANCE OF KISSEL MODEL FREIGHTER
DASH LINE C PERTAINS TO
PERFORMANCE OF AVERAGE 1918
2 TON COMMERCIAL TRUCK

Performance chart shows how a Kissel "Freighter" truck compares with the new type "A" U. S. Army truck after comparison of sizes, gear ratios and other units, was made.

### Building to Business Specifications

The business men of the United States have before them one of the greatest and gravest problems of the age—the herculean task of not only feeding and clothing at least one-half the population of Europe, but producing and delivering an endless variety of supplies, materials and equipment necessary to build up the millions of acres of devastated land and the thousands of destroyed towns.

In short—while in war time Production was the question of the day—in peace time Distribution is the problem of the day—with the motor truck as the logical solution.

Transportation delays must be eliminated—shipping efficiency must be increased—an endless chain must connect the source of demand with the source of supply.

### Determining Factors

Every business man who understands what a motor truck should do under varying conditions knows that first—to produce a well performing truck, it is of the greatest importance to properly select and combine the factors which govern the design properly; second—that with the capacity of the vehicle determined, the most important factors to be considered are the total weight of the truck, motor size, motor speed, rear axle ratio, tire size, speed of the vehicle and low gear ratio in the transmission; third—that only the proper selection and combination of these factors in any size truck and for any line of business will give the owner the results he looks for and which are—well balanced power transmission from motor to rear tires—good performance ability on levels and grades and low fuel consumption. These are the determining factors that have always guided Kissel in producing Kissel motor trucks.

### Analyzing the Results

On account of its adaptability to practically every requirement, the two-ton truck is the popular capacity.

When Uncle Sam was designing his type "A" Army truck he mobilized the Nation's greatest engineers to design a trouble-proof two-ton truck of unusual ability for military service.

At the same time the Kissel engineers had been developing a highly perfected truck of the same capacity and qualifications for commercial use.

When the motor sizes, gear ratios—in fact the whole power transmission from motor to rear tires—were compared, it was found that these factors were almost identical in both jobs, resulting in the Kissel Freighter more closely equaling the power, economy, hill-climbing and heavy road-pulling ability of Uncle Sam's truck than any other truck of like capacity.

Thus by carefully studying conditions at a time when truck performance was a vital necessity to the business world, the Kissel "Freighter"was so designed that it is a truck satisfactory in fuel consumption, showing great ability on level roads and grades, and well performing in every line of haulage work.

The "General Utility" has a chassis capacity including body of 4,000 lbs.—the "Heavy Duty" with a chassis capacity including body of 8,600 lbs.—the "Goliath," a giant in strength and power, with a chassis capacity including body of 11,800 lbs.

In addition, by June 1st Kissel will produce the new "General Delivery" truck, designed to meet the many urgent requests of present Kissel owners for a ¾ to 1-ton delivery truck to sell at a price that is moderate, but consistent with highest quality.

Among the many structural and mechanical Kissel truck features are—the powerful Kissel-built engine, designed and built at the Kissel factories for motor truck power purposes; amid-ship transmission on the "Freighter." "Heavy Duty" and "Goliath," eliminating a long propeller shaft and the possibility of whipping; rear axles of the most perfected type of worm-drive construction; frame of pressed steel, subjected to special tests and counter-tests for enduring strength and rigidity of construction; radiators of cast iron, rigidly constructed with ample cooling capacity. And so on—

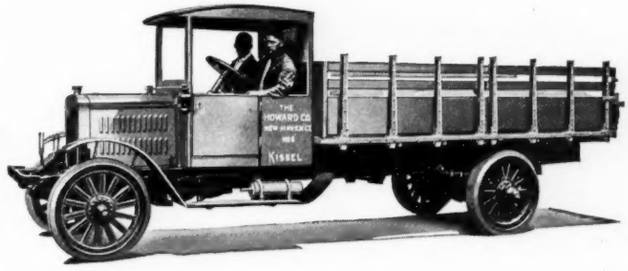
Result—perfectly balanced trucks—weight, size, dimensions, power, all related to one another in exact harmony—giving an incomparable chassis of perfectly balanced moving and fixed units, headlined by the powerful Kissel-built engine—trucks in which the haulage and delivery requirements of over 200 different lines of business are built-in at the beginning—that maintain schedules because they are built to overcome obstacles unsurmountable with trucks of less development and experience.

### The ALL-YEAR Cab

The necessity for uninterrupted transportation throughout the winter months prompted Kissel to originate the ALL-YEAR Cab—that protects truck drivers in wet and stormy weather—increases efficiency of the driver—and keeps trucks in operation the year round. In winter it is entirely closed. In summer, by removing the winter attachments, it becomes a cool, open housing.

Never before have the dependability, adaptability and economy of motor truck transportation become such a national business necessity as today. The unusual days ahead make it imperative for every business man—every manufacturing and industrial executive—to realize the vital importance of choosing the right make of trucks—which is the moral of this story. Such men should have the 1919 Kissel Truck Catalogue, showing how Kissel Trucks will fit their individual requirements.

Kissel Trucks are sold in all principal cities, where specifications and catalogue may be received, or direct from factory. KISSEL MOTOR CAR CO., Hartford, Wis., U. S. A.



# Prosperity—

INDUSTRY can be speeded up to its war pace, if you will do your part. There is no longer reason for hesitation. There is big work to be done in your business and in ours. Those who act promptly will make the most of the greatest opportunity America has ever had.

Pierce-Arrow trucks are available to do their part. Our experience is available to those who need our expert guidance in

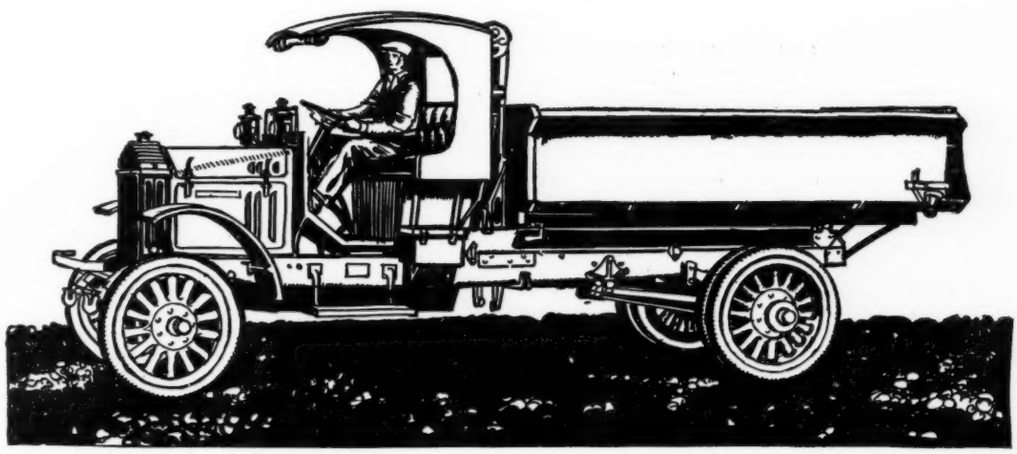
# PIERCE-ARROW

# depends upon you

expanding their transportation facilities or in redirecting them.

Don't wait. Call on us for aid to help you solve any problem that vexes you. We have met all conditions and made good in 148 different lines of business.

**THE PIERCE-ARROW MOTOR CAR CO.**
**BUFFALO, N. Y.**



**Delivers more work in a given time;**
**Loses less time on the job and off the job;**
**Costs less to operate and less to maintain;**
**Lasts longer, depreciates less and commands a higher resale price at all times.**

Salem bound trucks are heavily loaded with merchandise for farmers and merchants in small towns enroute. About 20 miles is over rough and mud roads which is a big handicap just now, but the trucks are making good time. This is indeed a practical application of the principles of the rural motor express as advocated by the Highway Transport Committee.

*A 52-Mile Motor Truck Freight Line in Nevada*

More than two years ago, L. J. Ginocchio, of Reno, Nev., saw the advantages of a motor truck freight line between his city and Gardnerville, 52 miles distant. He purchased a 2-ton Federal and began operations which proved successful from the very start. So much work was to be done that his brother purchased another Federal and went in with him.

General merchandise is hauled from Reno to Gardnerville and on return trips grain, flour and produce of all kinds is taken. One round trip is made each day by both trucks, requiring less than 7 hours for the 104 miles.

As a sample of the results accomplished, here is one week's report on one truck, in brief:

| | |
|---|---|
| Trips made | 7 |
| Loads in tons | 20.22 |
| Miles traveled | 728 |
| Gasoline—gallons | 126 |
| Cylinder oil—pints | 21 |

At the time this record was made, the cost per day of 104 miles was approximately $15. Ginocchio's freight line rate was $8 per ton. Thus the total cost for the seven days, was $105—the freight charges $161—a gain of $56.

*How a Road Contractor Saved Some Money and Could Have Saved More*

"An instance of saving that could have been affected was recently brought to our attention in the case of a New York contractor in hauling material for concrete road construction," says M. L. Pulcher, vice-president and general manager of the Federal Motor Truck Co.

"Loading was formerly done entirely by hand, requiring 20 minutes to load 2 tons. Teams cost $7 per day and made four trips hauling a little over 2 tons per trip an average distance of 3 miles. This made the commercial ton-mile cost about 29 cts.

"A 2-ton Federal was put on the job and made eleven trips, making a total of 66 ton-miles. The truck cost $12 a day and thus worked for 18 cts. per ton-mile, a fine reduction—saving 11 cts. per ton-mile and hauling 22 tons per day as compared to the 8 tons of the team.

"Yes, this was fine, but had the truck been loaded by overhead bins, for instance, the saving would have been much greater. Also the tons hauled would have been greatly increased.

"It required 3 hours and 40 minutes to load for the 11 trips. Unloading time was kept low by the proper dump body with which the truck was equipped. If a loading device had been used the truck could easily have been loaded in 2 minutes—a total of 22 minutes for the eleven trips. Let us allow 30 minutes which would easily care for the loading time. This would mean a saving of 3 hours and 10 minutes.

"The truck averaged 35 minutes running time per trip. In the 3 hrs. 10 minutes. it could make 5 trips and still have some time for delays. This would make a total of 16 trips,—32 tons—96 ton-miles for the day's work.

"The cost per ton-mile would then be a little over 12c. This means a saving of 17 cts. per ton-mile over the horse method—more than 50%, besides having hauled 24 more tons. This would also mean a reduction of 6 cts. per ton-mile —33 1/3% over that of the truck when loaded by hand, besides hauling 10 tons additional.

## Pinching Fuel Pennies and Wasting Truck Tire Dollars

*By A. F. Masury, Chief Engineer, International Motor Co., New York City.*

To many, economy, as far as motor trucks are concerned, means gasoline saving, but saving of tire cost is equally important. On a heavy truck, tire cost and fuel cost are about equal. On lighter vehicles tire cost is slightly less than fuel cost unless pneumatics are used, where the tire cost will slightly exceed fuel cost. Why, then, should we hear so much about means of saving gasoline and so little about economizing on tires. While the two items of cost are normally of equal magnitude, abuse of tires can raise their cost out of all proportion to their normal costs and can swell this item far beyond the utmost extravagance in fuel.

It is a fortunate circumstance that gasoline waste inevitably limits the ability of the vehicle to perform and that unless the carburetor adjustment is set for reasonable economy the truck will hardly operate at all and consequently cannot consume an excessive amount of gasoline. Tire abuse, unfortunately and to the contrary, limits the performance of the vehicle but little and in addition it gives rise to increased chassis maintenance cost and even increased fuel cost. It is no uncommon sight to encounter a truck whose owner is extremely particular about his carburetor adjustment, who employs the latest air-warming devices and insists that the engine be shut off at each stop, but with tires cut and slivered, wheels out of line and running on car tracks. A truck will actually consume less gasoline without a governor than with one, but removal of the governor and consequent overspeeding of the chassis imposes a heavy toll on tires.

*Some Common Tire Abuses.*

Commonest among tire abuses are overloading, overspeeding, running in car tracks, neglecting cuts and tears, spinning, skidding and sliding the wheels, and wheel misalignment. Overloading overstresses the tires beyond their elastic limit, utterly destroying the life of the rubber and the durability and cushioning ability of the tires. Overspeeding, even with a light load has the same effect, since the increased speed causes the impact of the tire on road bumps to be magnified. Running over a bump at twice normal speed pounds the tire eight times as hard and consequently may overload it at one spot 400 percent.

Running in car tracks simply cuts the tires by centering the pressure at one point instead of evenly over the tread as is proper. The edges of the rails, particularly of the guard flanges of street-car tracks become sharpened by the friction of the car wheels and running tires over them is much like running them over the edges of steel knives.

When solid tires are cut or torn by glass or sharp stones, the rubber slivers, much as the cuticle of the finger on a hangnail. Anyone who has been troubled with this annoying condition knows that if allowed to go without attention, the hangnail will split further until it becomes exceedingly painful and results in an enduring disfigurement of the finger. If it is promptly cut close to the flesh it will soon heal and disappear. Similarly slivers on solid tires should be promptly cut off entirely as soon as they appear. Care should be observed that a clean notch just below the end of the tear is made. If the sliver is left on, it will contribute nothing to the strength of the tire, but will continue to flap and the tear will extend until half the tread width is torn loose.

Spinning and sliding the tires in starting and stopping and skidding in rounding curves also have a serious destructive effect. Upon loss of traction, more drivers than not will speed up their engines under the erroneous impression that this will increase traction. It actually does the exact reverse. The slower a wheel turns the better traction it has. The more gently it is started turning, furthermore, the less liable it is to slip. When a wheel begins to lose traction, the driver

# This Transmission Avoids 60% of All Truck Troubles

*Gramm-Bernstein is particularly well situated to furnish dump trucks for road-building, public works and general building operations because of its power take-off patents. The power take-off necessary for operating a dump body, winch, or log roller, is easily applicable to the transmission.*

*Dealers and others, in purchasing trucks and passenger cars having any kind of power take-off for operating hoist, winch, log roller, tire pump, etc., should assure themselves that such device does not infringe upon B. A. Gramm's basic patent No. 1194994.*

**THREE outstanding facts about the Gramm-Bernstein transmission are of very great importance to business men and truck buyers:**

**It avoids fully 60 per cent of truck troubles.**

***No Gramm-Bernstein owner has ever replaced a complete transmission for any cause, not even accident.***

**Forty cents per truck was the average replacement cost, over a carefully recorded period of fifteen months, on all the Gramm-Bernstein transmissions in use, aggregating several thousands.**

**These facts *are* facts because this is the one transmission which is proof against every trouble, and which therefore eliminates a source of very heavy truck expense.**

**Large operators of motor trucks figure that 60 per cent of lay-ups are due directly to transmission difficulties.**

**The gears in the Gramm-Bernstein transmission cannot be stripped. They are always in mesh.**

**They are wholly proof against a driver's carelessness or ignorance.**

**Speed changes are mace by means of patented dog-clutches.**

**The gears cannot get out of alignment. They are assembled on six-spline shafts, without the use of a single nut, bolt, stud, setscrew, key, pin, or anything else which could possibly work loose and fall out.**

**This transmission is an exclusive feature of the Gramm-Bernstein line of heavy-duty, worm-drive trucks, now sold completely equipped.**

**Capacities include 2, 2½, 3½ and 5 tons.**

**All complete and ready for the body. Not an extra to buy.**

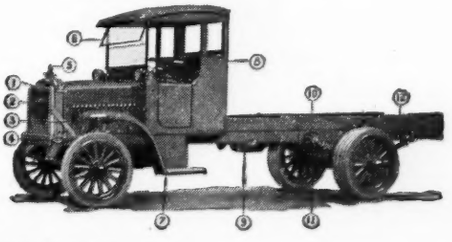
*Gramm-Bernstein Radiator, showing radiator open, radiator guard, pig-tail towing hooks and motometer.*

## First Line of Heavy-Duty Trucks Sold Completely Equipped

***Equipment now supplied with Gramm-Bernstein heavy-duty worm drive models listed below. Illustration shows 2-ton worm drive truck—$2700***

***This price is under the average asked, for 2-ton chassis without equipment, by 61 manufacturers***

(1) Sturdy radiator guard, attached to frame independently of radiator—the Gramm-Bernstein type adopted for Liberty Trucks.
(2) Radiator shutter, operated from dash.
(3) Rear radiator shroud devised by B. A. Gramm and adopted for Liberty Trucks, to promote cooling efficiency.
(4) Pig-tail towing hooks at front end.
(5) Motometer, to indicate temperature of engine.
(6) Exceptionally rugged ventilating windshield.
(7) Front fenders and steps.
(8) Standard Gramm-Bernstein cab, with doors and winter curtains.
(9) Transmission, patented Gramm type, with gears always in mesh.
(10) Body sills of seasoned ash, ready for mounting the body.
(11) Patented wick oilers on all spring bolts.
(12) Spring drawbar at rear end, supported by extra cross member.



## The Gramm-Bernstein Motor Truck Co.

**Lima, Ohio, U. S. A.**

***Pioneers since 1901—Builders of the first Liberty (U.S.A.) Trucks.***

should throttle down his engine rather than speed it up, retarding his spark and being ready to release the clutch to prevent stalling. In engaging the clutch it is well to let it in gently. Low gear should be used as this will permit the wheels to be turned very slowly without so much danger of stalling the engine.

In applying the brakes, the wheels should not slide. Not only does sliding the wheels injure the tires, but it reduces the braking effect. The quickest stop is made when the wheels are just turning and the abrasion on the tires is least. Skidding on rounding curves is unnecessary. It is dangerous. It is due to turning at excessive speed. In some of our cities, such as New York, it is illegal. All of these tire abuses do untold harm to the tires. A tire is made to roll over the ground, not to slide. Sliding the wheels of railroad cars causes flat wheels. If sliding a hardened steel tire over a smooth steel rail for a few seconds can so abrade the wheel that its

VIEWS ILLUSTRATING EFFECTS OF SOME OF THE MORE COMMON ABUSES OF MOTOR TRUCK TIRES.

(1)—Overloading as effectually destroys tires as it does all other portions of the chassis. Note peripheral crack near the base and separation of the tire at base.

(2)—Overspeeding on solid tires is suicidal as this prematurely disintegrated one bears tragic witness. If high speed is necessary, pneumatics should be applied. Though they cost more, they are much cheaper than solids so utterly destroyed as this one after a few hundred miles of abuse.

(3)—Car tracks are made for street cars, not for Motor Trucks. The wreck of a tire here shown is an advertisement of an incompetent driver and an owner who is wasting money needlessly.

(4)—Time is money, but when a truck turns a corner so fast that it skids or is brought to a stop by sliding the wheels, the infinitesimal saving in time is hardly justified by the utter ruin of an expensive tire which results.

(5)—Tire hangnails and cuts need not ultimately tear great chunks from the tire and bring it to the untimely end pictured here. Simple surgery, familiar to every manicure, would have saved this tire.

(6)—Spinning the wheels or permitting them to run out of line is as bad as running the engine without oil. It will destroy the tires rapidly and is scarcely less expensive than replacing burned bearings.

pounding will crack 150 pound rails, fancy the damage to a rubber tire in skidding or sliding over a road of stone or concrete.

*Faulty Alignment.*

Besides these more obvious causes of excessive tire wear, there is an insidious cause which is too likely to be overlooked. This is faulty alignment, the tire rolls smoothly and with the minimum of wear, but if out of alignment, it has a combination rolling and sliding movement over the road, which causes rapid wear and consumes power. There are two forms of faulty alignment, namely, that in which the wheel itself is out of true, so that it wobbles and that in which the wheel spindle is at an improper angle so that the wheel is constrained to a position out of parallel with the direction of vehicle motion.

Wheel wobbling is caused by strains and warping of the wood. Some of the strains which get wheels out of true can be avoided. When a truck is driven diagonally into the curb, when a corner is rounded too sharply or a boulder is struck a glancing blow, the severe lateral strain at one point of the circumference of the wheel is apt to warp it. Sometimes carelessness in applying or removing pressed-on tires warps the wheel and in some cases a careless operator will press the tire on crooked, so that the effect on the tire is the same as a warped wheel. The remedy is to have the tire pressed off and the wheel trued by a wheelright.

Misalignment of the wheel spindles is due to excessive shocks, such as running into curbs, overspeeding on rough roads and so on, which bends the axles, or the steering arms of the front steering knuckles. The destructive effect of a slight misalignment can readily be appreciated. when one realizes that if a wheel is only out of line 1 degree horizontally, it must slip 92½ ft. sidewise in a mile of travel. The destructive effect upon the tire is the same as though the truck were pulled sidewise this distance by a winch. And 1 degree in only equal to about 9/32 in. on the periphery of the tire.

Alignment of the wheels can only be made true by accurately checking the distance between the wheel felloes. There are several good ways of doing this and a number of methods that are not so good.

Most motor trucks have their rear wheels dead parallel. To check their alignment, the simplest method requires two men and a tape. The end of the tape is held against the front side of the inside face on one rear wheel and the tape stretched across the corresponding point on the opposite wheel, care being taken to have the tape level and stretched tight. The bottom points of the felloes are then checked, and then the rear points. All three of these measurements should be the same. The most common misalignment of the rear wheels is what is called a spraddle. By this is meant that the bottoms of the wheels are further apart than the tops. If this condition is found, the wheel bearings should be inspected for looseness first. If these are properly adjusted, then the axle should be straightened.

Front wheels should not be parallel. For greater strength and easier steering they are cambered. By this is meant that the wheels are further apart at their tops than at their bottoms. To correct the resulting tendency for them to roll incorrectly, they are correspondingly gathered at the front. By this is meant that their fronts are drawn in or toed-in usually about 3/8 in. Measuring as before, correctly aligned wheels will have their bottoms and their fronts about the same distance apart. The bottoms may be 1/8 in. closer together than their fronts, but should not be farther apart than their fronts.

AMERICA again has called upon the power and resource of her motor trucks—this time to catch-up her war-interrupted building program.

Just as the nation's calls for war-supply and food-supply were answered, so this newest call is being answered by the combined strength of thousands of trucks. Nothing but the motor truck matches the speed of steam-shovel excavation. No other carrier is adequate to modern building methods.

Thousands of Federals are making good for builders—giving always that complete satisfaction which has brought from the public an ever increasing demand for more.

*"Shorten the miles to market —build better roads"*

*"Federal Traffic News," a magazine of modern motor haulage, will be sent free on request to responsible executives.*

Federal Motor Truck Company
Detroit, Michigan

# FEDERAL

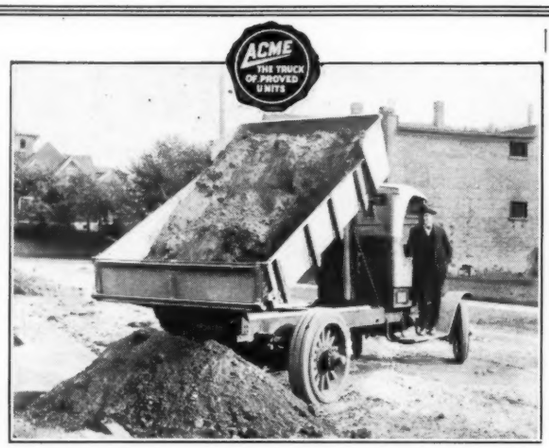
*One to Five Ton Capacities*

If these measurements do not check, the gather at the front may be adjusted by means of the tie-rod, which is threaded for adjustment. Before adjusting the tie-rod, however, it would be well to assure oneself that the steering arms have not been bent. This can be determined by measuring the distance from the ball or pin, as the case may be to the wheel felloes. The two arms should be the same distance from their respective wheels. If they are unequal, the one that is bent should be straightened until it is the same distance from the wheel felloe as its mate and the final adjustment made on the tie-rod.

So far, these checks apply only to the relation of the wheels with each other. Another important check must be made on the alignment of the axles with the frame. Naturally the axles should be perpendicular to the chassis center-line. This can best be checked by selecting a fixed point at the center of the frame, such as the front universal and checking the measurement from it to the nearest unobstructed point on each rear wheel. The two should be equal. If unequal, be sure that the truck is on level ground and that the two rear springs are deflected equally. This may be checked by measuring the distance from the bottom of each frame side-rail to the axle. If unequal, a jack may be used to raise the low side of the axle to the same height as the other side. The measurement to the universal can then be repeated. If it is found to be still unequal, the cause will be found either in unequal radius rod adjustment, or if no radius rods are fitted, in loose axle spring clips which have permitted the springs to shift.

At the front a similar check may be made from some central point on the crank case to opposite points on the wheels.

Too many motor truck users neglect to check their wheel alignments until the occurance of an accident or other cause that necessitates a serious repair. Misalignment is likely to result from minor causes in daily service and unless frequently checked may go unnoticed, bringing about excessive tire destruction without readily apparent cause.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The thickness of stone is regulated by raising or lowering the gate of the spreader. By the use of the wing attachment shown in the illustration, the stone can be spread the entire width of the pike at the specified depth. Wings are adjusted for width of spread and also for depth of stone. A crown to the road can be given by raising wings higher in center than at ends.

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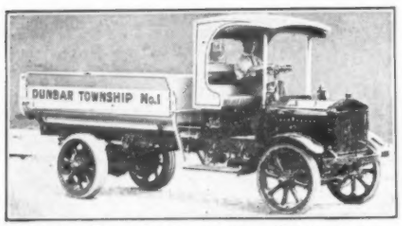

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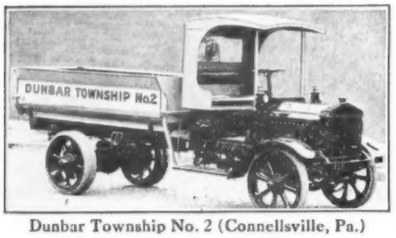

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"The HALL truck which we operate in the south end of the County has given good satisfaction on the work for which it has been used, namely, hauling materials and tools on road, bridge and culvert construction and repair. This truck has caused no expense outside of oil and gas, except a few dollars for grinding the valves, and has seen about twelve months' service."
—*L. K. Forde, County Engineer, Alfalfa County, Cherokee, Okla.*

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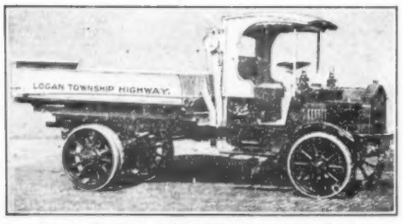
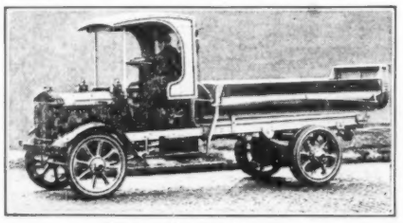
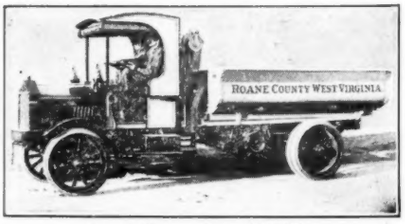


Logan Township Highway (Altoona, Pa.).


Cowley County, Kansas.



Roane County, West Virginia.

# EDITORIALS

### Resist Pressure for Cheap Construction

The engineer should now, more than ever, resist the pressure brought to bear on him by taxpayers and non-technical officials in favor of cheap construction. In ordinary times this pressure is considerable, and it reaches its greatest intensity in times of abnormally high prices, like the present time. There are many evidences that the uninitiated are agitating for shoddy construction to offset, in part, the advance in the cost of high-grade construction.

The engineer who yields to this sort of pressure lets himself in for a vast amount of trouble. Those who are most insistent that he adopt inferior materials to save money are the first to condemn him when these materials fail to give satisfaction later on.

The surest thing we know after years of close study of public improvement activities is that the poor improvement never gives satisfaction, no matter how low its cost, and the good improvement always gives satisfaction, no matter how high its cost.

When an improvement is proposed, both its cost and its probable performance are considered, but after the improvement is placed in service its cost is quickly forgotten and its performance alone remains of interest to the public.

### Why Some New York Road Contractors Defaulted

During the year 1918 the New York State Highway Department completed a number of road contracts on which the contractors had defaulted. One of the polite fictions of the season was that these contracts were abandoned "on account of the war." What a multitude of sins that war has been made to cover!

It is most illuminating, however, to read more of these abortive contracts in the annual report of the Supervising Engineer. He says:

"It is the current custom to ascribe failure on public work operations to the war, but this reasoning was only partially responsible for the various contracts which the department was forced to complete. Most of the failures can be traced back to the ruinous competition of 1914, 1915 and 1916, brought on by the influx of many inexperienced contractors. In some cases a certified check for bidding purposes was obtained from a bonding agent; a bond procured from this agent's company; a plant bought for a few dollars plus six, nine and twelve-month notes; the president of some rural bank procured as a co-partner so that the first payrolls might be met; and finally the proceeds of monthly estimates were assigned to material manufacturers so that work could proceed. Such combination as outlined above, together with the gradual increase in the cost of labor, had far more influence upon the resulting abandonment of contracts than the entry of the United States into the world war."

The irresponsible low bidder is, as we have before remarked, the cause of much grief to others as well as to himself. Making no allowance for contingencies and adverse weather and labor conditions, he bids so low that he breaks himself or somebody else, or at least forces prices down to a level where all legitimate profits disappear. It is a plain duty of the engineer to advise the public to beware of the lure of the low bid filed by the irresponsible low bidder.

### Make the National Highway Bill a Law

The National Highway Bill, commonly referred to as the Townsend Bill, was introduced in the United States Senate on June 2 by Senator Newberry, of Michigan, acting for his colleague, Senator Townsend. The bill was promptly referred to the Committee on Post Offices and Post Roads.

The bill is designed to establish a national highway system, to create a Federal Highway Commission, to encourage efficient and economical highway transportation, and to accomplish other purposes.

The bill embodies the national policy and plan promulgated at the joint meeting of the American Association of State Highway Officials and the Highway Industries Association held in Chicago last December.

All those who have made a study of this question and believe that it is for the best interest of each state and of the nation to create a Federal Highway Commission to establish a national highway system, should use their influence to have this bill enacted into law. It is officially designated as Senate Bill 1309. Write your Senators and Representatives in support of this most constructive measure.

### The Price Conspiracy

The public official who cannot satisfactorily explain the present high prices prevailing in the improvement field must be strangely barren of ideas and bereft of information. All prices are high; the prices of most commodities are relatively higher than those of public improvements. This is not an unsupported assertion made in the interest of the construction industry, but is a statement of fact based on statistics compiled by the U. S. Department of Labor and recently made public. Here is just one sentence quoted from that high authority:

"At the close of the war the index number for building materials, not including steel and other metal products, had risen only 61 per cent. over the pre-war prices of 1913, while the index number for commodities, exclusive of building materials, had risen 113 per cent."

Occasionally some reader of this journal writes to us accusing us of aiding and abetting a high-price conspiracy in the interest of patrons of the magazine. This attitude is ridiculous. If we were alone in urging the making of improvements at present prices, our motives might be questioned, but there are numerous disinterested authorities, both in and out of the public service, who are urging the people to build now without awaiting the return of low prices, which may be years in arriving, if they ever do arrive. For example, the Director General of the U. S. Department of Labor recently said: "Business is being held back and the nation's resources of human and mechanical produc-

tion wasted because of the existence in some quarters of an unreasonable fear of a sudden price recession. Careful study of all the precedents and present economic factors points toward a very slow and gradual price readjustment."

Many other authorities could be quoted, including John Hays Hammond and Maj. Gen. George W. Goethals, to show that if there is a price conspiracy and we are in on it, we are at least in good company.

### Will the American Association of Engineers Adopt Trade Union Methods?

As in recent issues, we shall continue having a good deal to say in these pages about the American Association of Engineers. Not only are we fully and finally convinced that the association is already a tremendously successful going concern, but this year the association is planning to co-operate with public engineers to secure for this class of engineers better employment conditions, including greater compensation and greater security in office. Since this magazine is devoted to the interests of the engineer in public service, it is our clear duty to co-operate with the association in this work.

In all frankness it must be admitted that in coming to the aid of the association at this time we are, as the Europeans say, "merely succoring the victor." The association is already a victor, having risen to great heights from a most humble origin. All we can hope to do is to assist in reducing to a minimum the time yet required by the association to draw all engineers to it and to gather the full fruits of its victory over inertia, reaction and prejudice within the profession.

There still persists in some quarters, among those who have not fully informed themselves in the premises, the belief that, simply because the association is exercising organized effort on behalf of the engineer, it is about to adopt or has already adopted trade union methods. The engineer need have no fear that the association will adopt any method that will reduce the profession to a trade.

The editor was not the only one who looked on from the side lines for a good while before deciding to co-operate with the association. Recently a prominent railway paper published an editorial entitled, "Shall Engineering Be a Profession or a Trade?" In a letter commenting on the editorial the chief engineer of one of America's greatest railway systems said:

"You say the American Association is patterned in many ways after the trade unions. Before deciding to join the American Association I studied this very carefully, as I am strongly—I might say violently—opposed to the introduction of trade union methods into an engineering organization. I was thoroughly satisfied that the American Association, beyond being a business organization, as is the United States Chamber of Commerce, had nothing in common with trade unionism and had no intention of adopting trade union methods."

Such testimony should refute the baseless charge that the association is merely "a glorified trade union."

### Convinced of the Necessity for Organization

Engineers in public service who are interested in improving their conditions of employment will not fail to read the article in this issue that tells how the engineers and draftsmen in the municipal service at St. Louis turned to the American Association of Engineers for help, after trying vigorously but vainly to get justice without being organized. The men turned to the association because, says the author of the article, "they were convinced of the necessity for organization."

Never before have so many engineers appreciated the need for organized effort as they do today. This is true throughout the country. Local organizations are springing up at various points. Some of these incline toward trade union methods, but the inclination is not likely to be followed for the reason that local leaders are coming more and more to realize that affiliation with a national organization is highly desirable, and they are turning toward the American Association of Engineers, which is not operated on trade union lines.

It is not strange that engineers here and there are discussing organization. They have tested to complete failure the old plan of individual effort. The regulation thing in any line of business today is organization. Organization forces organization. When there are various combinations and organizations in the business world the groups that remain unorganized can expect nothing better than the worst of it in the economic struggle. It is really too late to discuss the desirability of organizing. Engineers are not confronted by a theory this time, but by an accomplished fact.

The American Association of Engineers has been called "the engineer's Chamber of Commerce." It looks after all the business interests of engineers as a class. It will be a great day for engineers when the association has affiliated chapters and clubs in all parts of the country, corresponding to local chambers of commerce, all co-operating with the central organization. Then the engineering profession can speak with a single voice, not only for itself, but in safeguarding public interests in all matters where engineers have expert knowledge.

To oppose organization is to oppose progress, and opposing progress is a peculiarly futile and hazardous enterprise.

### Should the Engineer Enter Politics?

To raise a question as to whether or not the engineer should enter politics is equivalent to asking whether or not he should perform the duties of citizenship and whether or not he should obey the law of self-preservation, which is said to be the first law of nature.

Enjoying the privileges of citizenship, the engineer, like other men of affairs, should perform its duties, among which is participation in local governmental activities. The analytical engineer should appreciate the uses of politics as well as its abuses; it would be the better for his participation in it. Many matters of an engineering nature are disposed of through political processes, and assuredly it is the duty of the engineer to engage in political discussions of this sort, where his training and experience fit him to be a leader of public opinion.

The engineer in public service is often made and as often unmade by the rotation of the political whirligig. If he does not participate in politics in such a case, he is leaving his destinies strictly in the hands of other men. He can scarcely afford to assume an attitude of dignified neutrality where his vital interests are concerned.

There is an unusually interesting article in this issue on the engineer in politics. It is just another indication that the engineer is no longer content to take merely a thinking part in the affairs of men. He is looking for more action.

# The Design and Construction of Modern Granite Block Pavements With Special Reference to Practice in Borough of Manhattan

*By C. M. Pinckney, Chief Engineer, Dept. of Public Works, Borough of Manhattan, Municipal Building, New York City.*

FOR the purpose of this article we will consider all types of pavements whose road metal or wearing surface is of granite.

*Types of Granite Pavement*

There are several types of granite pavement now in use. First, the large, roughly dressed block type laid on a sand, or in some cases a concrete foundation with a cement grout or a bituminous joint filler. Second, the improved, well dressed, small block type laid on a concrete foundation with a cement grout or a bituminous joint filler. Third, the small block type consisting of 4-in. regular cubes laid on a concrete foundation with a cement grout or a bituminous joint filler. Fourth, Durax type, consisting of irregular shaped, roughly cubical pieces of granite fitted together in segmental arcs on a concrete foundation with a cement grout or a bituminous joint filler. Fifth, the reclipped block type; and sixth, the napped block type.

*Advantages of Granite Block Pavements*

It may be truly said of granite block pavement that it is the only type of pavement that is afforded an opportunity to wear out, rendering adequate service with a minimum of inconvenience to the traveling public every day of its life. In other words, its failure is not induced or aided, as in other types of pavement, by certain inherent characteristics of the material itself, which tend to lend themselves to, rather than resist, certain agents of destruction which are normally present in a large city. It is entirely free from the disintegrating effect of water; it is not affected by gas or steam leaks, and it offers more resistance to small fires than any other type of pavement. It is the only type of pavement, with the possible exception of the waterbound macadam (now a relic of an antiquated past) that offers salvage after many years of service. It is likewise the only type of pavement that is adaptable to extreme conditions of traffic and street gradients combined.

*Modern Granite Pavements Are Not Noisy*

Objections are sometimes offered against the selection of a granite pavement on the ground that it is noisy, the objectors having in mind the old type of granite block pavement over which the passage of a heavy load caused the buildings to shake, and the windows to rattle. They seem to be wholly unaware that the modern granite pavement is noiseless when completed, and remains so for about two years, after which the joints may be refilled with bitumen at a small cost (about 20c per sq. yd.). Such treatment at intervals of two years will result in a comparatively quiet pavement during the greater part of its life.

*Requirements Essential to Good Results with Granite Pavements*

A successful granite pavement is only obtained by the observance of a series of details; each detail in itself meriting careful attention in order that the desired effect may be

VIEWS OF GRANITE BLOCK PAVEMENTS, BOROUGH OF MANHATTAN, CITY OF NEW YORK.

Top Row: Modern Granite Pavement on Lafayette St., at Duane Street—Recut Granite Pavement on 79th Street. Bottom Row: Durax Pavement Being Laid on West Street—Old Style Granite Pavement on Washington Street, at Leroy Street.

secured. The granite used must be reasonably hard and tough. In fact, toughness is a more desirable physical characteristic than hardness. It must be a fine-grained, clean-splitting stone. The blocks must be uniform in dimensions, particularly in the width and depth and they must be so dressed that the heads shall slightly cover the blocks and have no irregularities greater than ¼ in. from the general plane of the head.

*Dimension of Blocks*

The Borough of Manhattan's specifications provide that the dimensions of the blocks shall be as follows: From 6 to 10 ins. long, 3½ to 4½ ins. wide, and 4¾ to 5¼ ins. in depth. In this locality the blocks are inspected upon arrival, and if 15 per cent. of the first thousand blocks, selected at random, are found to be defective, the cargo is rejected. The acceptance of the cargo as a whole, however, does not operate against the culling of individual blocks, while the work is in progress.

*Handling the Blocks*

Upon the acceptance of the cargo, it behooves the engineer or inspector to see that the handling of the blocks is attended with some degree of care. Nothing is more conducive to the defeat of a good purpose than the careless handling or rehandling of paving blocks. It must be remembered that every time a block is thrown into a pile of blocks, at least two blocks are damaged. Consequently, careless handling or unnecessary rehandling of the blocks should be avoided.

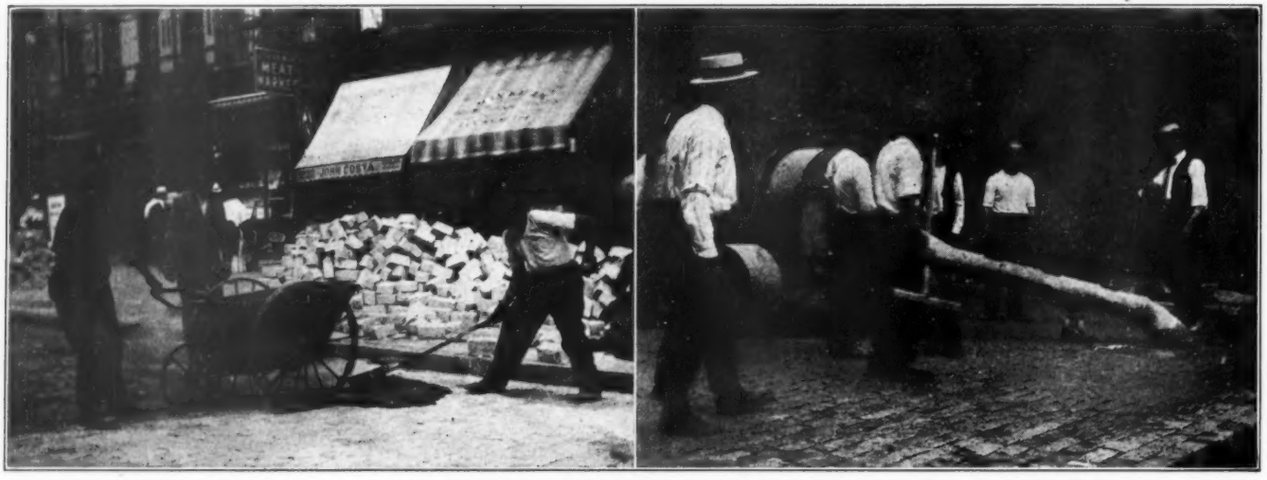
*Concrete Foundation Imperative*

As the pavement is merely a wearing coat only, capable of resisting the abrasive action of traffic, its behavior under the shocks of impact and the enormous wheel loads, which modern pavement is called upon to bear, is entirely dependent upon the stability of its foundation.

Prior to 20 years ago, it was the common practice—notwithstanding the scriptural injunction against founding our houses upon sand—to found our granite pavements upon a sand foundation. The fallacy of laying a pavement consisting of a number of separate yielding units soon became apparent as the motor vehicle increased in popularity and tonnage capacity, until at the present time, one would as soon think of constructing a pavement in mid-air as he would of laying a pavement without a concrete foundation. But even under the disadvantages of being poorly founded, these granite pavements rendered good service in the past and lasted many years under the light, slow-moving traffic of their time. Now, however, the almost universal use of the fast-moving heavy motor vehicle requires all pavements to be founded upon a firm concrete foundation.

*The Concrete Foundation*

The concrete used for this purpose should be not less than 6 ins. in thickness. The aggregate should be composed of a well-graded, broken stone or gravel, and the matrix should be a clean sharp sand and a good grade of Portland cement. The materials should be mixed in the proportions of 1 part of cement, 3 parts sand, and 6 parts of stone. A mechanical batch-mixer should be used, and each batch should be carefully measured and mixed until all of the materials are thoroughly incorporated. Before the concrete is deposited, the subgrade should be shaped and rolled until final compaction is assured. The concrete is then deposited in a uniform layer from curb to curb. It should be spread and shaped by raking, and by liberal application of form templates, until the top surface is smooth and parallel to the finished surface of the pavement. It is quite important that the finished surface of the concrete should have no projecting points of stone, as these points will interfere with the proper bedding and ramming of the paving blocks, frequently causing some of the blocks to rock and become loosened or broken after the pavement is completed and opened to traffic.



VIEWS SHOWING CONSTRUCTION OF GRANITE BLOCK PAVEMENTS IN BOROUGH OF MANHATTAN, NEW YORK CITY.
Left: Applying Bituminous Filler. Right: Method of Grouting Reclipped Blocks.

*The Mortar Cushion*

After the concrete has set, a dry mortar cushion composed of sand and cement mixed in the proportions of 1 to 3 should be spread over the concrete in sufficient quantities only to supply the pavers with a bedding for the stone. The virtue of this mortar cushion lies in the fact that it offers an impervious impedient to any unsuspected small streams of water which would undermine a sand cushion and cause an irregular settlement of the pavement at some later time.

*Ramming Blocks the Most Important Detail*

After the paving blocks are set in, place stone against stone with close joints not exceeding ⅜ in., the end joints being properly broken, the rammersman proceeds to ram the blocks down to a solid bearing. This is probably the most important detail in connection with granite block paving, as every block should be struck full on the head with sufficient force to drive the block home to a solid bearing without fracturing or spalling it. The rammersman, after thoroughly ramming the whole surface, removes the low blocks by means of tongs, the use of pinch bars being avoided as the action of the pinch bars tend to disturb the alignment of the courses and widens the joints. Sufficient mortar is then placed under the low stones to bring them to the general plane of the surface of the pavement and the whole pavement is again rammed until every stone is well founded and the heads of the paving blocks form a true and unbroken

surface. Should this detail be neglected it will not be discovered until traffic has rammed the pavement, forcing down the blocks that are insufficiently bedded and spalling or cobbling the edges of the high blocks, leaving an uneven paving surface which is destined to early failure.

*Filling the Joints*

The filling of the joints is also an important item in granite block pavement construction. The joint filler may be a bituminous mastic composed of asphaltum or coal tar, and a finely graded sand, which has been previously heated before mixing, or a cement grout.

*Bituminous Filler Exclusively Employed in Manhattan*

In some cities local conditions do not permit the use of the cement grout filler as barricading the streets for such a considerable period of time in order to afford the grout an opportunity to harden would seriously inconvenience the business interests in the street and also the traveling public. The necessity for frequent openings and disturbances of the pavement in some cities primarily due to the location of subsurface structures such as water and gas mains, electric conduits, etc., precludes the use of this material for joint filler, as the work involved closely resembles a quarrying operation or masonry excavation, leaving no salvage to temporarily repair the opening until final restoration can be made. Where this filler has been used under satisfactory conditions, it has invariably given excellent results. Because of the aforementioned objections, the borough of Manhattan has been compelled to confine itself to the use of the bituminous paving filler exclusively.

*Preparation and Use of the Mastic*

Due care must be exercised in the preparation and use of a mastic so as to avoid the errors common to work of this character; otherwise, the resultant product will fail in its purpose and will not come up to expectations. It is essential that the bitumen or coal tar be heated to the proper temperatures (bitumen 300 to 400 degrees F.—coal tar, 250 to 300 degrees F.). Overheating is fatal as it tends to lower the ductility of the material which, upon hardening in the joints, becomes brittle and is quickly broken by the impact and shocks of traffic and is soon jarred out, leaving the pavement unfilled and raw, thus affording traffic an excellent opportunity either to loosen or cobble the paving blocks. Hence, a thermometer should be kept in the tank at all times while it is in use, and should be frequently consulted by the inspector who should see that the tank fire is so regulated that there is no danger of the material overheating. The mineral aggregate of this mastic should be a clean fine sand which should be heated before mixing with the bitumen; the two materials being used usually in the proportion of 1 to 1.

*Two Methods of Mixing and Placing the Mastic*

There are two methods employed in mixing and depositing the materials of this mastic; one is by drawing the hot bitumen from the tanks in the pouring buckets; adding measured quantities of hot sand thereto, and stirring with a wooden paddle to insure the suspension of the aggregate, the mastic being then poured from these buckets into the joints. This method is crude and not in keeping with the best methods of modern practice. The main objection offered is that the process of pouring the joints is rather slow, sufficiently slow to enable the mineral aggregate to settle in the bottom of the bucket before it is half emptied. The second method is to employ a mechanical mixer and draw the mastic off in carry-alls, dumping it quickly upon the pavement and working it over the surface and into the joints by means of squeegees. This method is by far the more preferable, as the suspension of the mineral aggregate is maintained by mechanical agitation right up to the very moment of its use, and the method of depositing the mastic does not occasion sufficient delay to afford the sand an opportunity to settle. A thin layer of sand should be spread over the finished pavement as protection against the traffic carrying the mastic away, as unlike a grouted pavement, this pavement may be opened to traffic within a few hours after its completion.

*Present Excellence of Granite Pavements Due to Co-operation*

The substitution of the small granite block for its large mis-shapen predecessor, succeeded in bringing about a radical change in the block-making and paving industries. Where the large block was merely a crude product manufactured by the paving cutter from the grout or waste material of every quarry without serious thought or endeavor on the part of the manufacturer to turn out a product best suited for its intended purpose, the small improved block represents the most finished handiwork of the paving cutters' craft. It is manufactured from quarried dimension stone, only fine-grained granite being selected for the purpose. The labor

VIEW OF CONCRETE FOUNDATION READY TO RECEIVE GRANITE PAVING BLOCK, BOROUGH OF MANHATTAN, NEW YORK CITY.

employed in the manufacture is highly skilled, the whole operation being attended by close supervision and inspection, and the completed paving block is subjected to careful handling and delivery.

The pavers and rammers, also, through the process of industrial education developed by the labor organizations and others interested in good pavements were among the first to co-operate and lend their very necessary assistance toward the perfection of the present granite block pavement, and the paving contractors, too, men who were formerly only interested in large yardage at small outlay with a consequently high percentage of profit, they, too, are imbued with a like spirit of co-operation and a feeling of justifiable pride in the completion of a piece of work that has been well done and in which they have played some part.

*The 4-in. Cube Granite Pavement*

The small 4-in. cube type of granite pavement consists of granite cubes 4 ins. in dimension. It is laid on the same foundation, and in a similar manner to the improved granite pavement. Except for the purpose of holding an old concrete foundation, this type of pavement is rarely selected in this country—the multiplicity of joints and the small head area of the units being the chief objectionable features.

*Durax*

This type of pavement has been quite extensively used in some of the large cities of Europe, notably, Liverpool, Hamburg and Berlin. It consists of irregular pieces of granite, roughly cubical in shape, about 3½ ins. in dimension. It is laid in the form of segmental arcs instead of regular courses. The foundation and joint filler are the same as described for other types of granite pavement, though the operation of paving is somewhat different. Like the cube block type, Durax may be well employed as a resurfacing pavement to replace a shallow type of pavement, retaining the old concrete foundation. It has not attained popularity in this country owing to the difficulty of obtaining labor sufficiently experienced in the laying of the pavement, and also due to

the fact that in localities where street openings are frequent it is difficult to repair.

*The Reclipped Block Pavement*

The reclipped block offers an excellent illustration of how a granite pavement at the termination of its usefulness may be, at a small cost, completely rejuvenated and placed in a condition almost equal to that of a new pavement. The old blocks are removed, and the concrete foundation retained; sufficient concrete being added thereto to raise it to the new grade; to fill in all of the irregularities, and to correct the contour. The old blocks are clipped and dressed at the site

VIEWS SHOWING THE QUARRYING OF GRANITE PAVING BLOCKS.

Top Row: Close-up View Showing how Stone Lays in the Quarry—An Extensive Granite Quarrying Operation in the East. Bottom Row: Showing Regular Formation of Stock as it comes to the Paving Cutter—The Finished Product at the Quarry.

of the work until the finished product closely resembles new blocks in all respects, though somewhat smaller in dimensions. The operation of clipping should be done only by skilled and experienced paving cutters, and it should be attended by the closest inspection; otherwise, the blocks may be napped instead of being clipped. The blocks are paved in a manner similar to that described for the modern granite pavement, and the joint filler may be a cement grout or a bituminous mastic.

*The Napped Block Pavement*

The napped block pavement is another type of granite pavement constructed from the salvage of the old granite blocks. It differs from the reclipped block pavement insofar as the blocks are merely broken in half and laid with the broken ends up; joints being consequently wide, are invariably filled with a cement grout filler.

*Life of Granite Block Pavements*

The question of the life of a modern granite pavement is governed by too many variable factors to permit of a direct answer. While it is true that many of the granite streets in New York City today are 25 years old and over, it must be borne in mind that the streets referred to are not important thoroughfares, and that the pavement thereon has only successfully withstood the character of traffic common to its time. How long the same pavement would live under the traffic conditions of today, or the traffic conditions of a few years hence is merely a matter of conjecture, as traffic is rapidly assuming the form of an indeterminate variable to which no known value can be assigned. So far, by the use of improved materials and methods of construction, we have kept pace with the greatly increased traffic conditions, but we are fearful that the motor vehicle manufacturers who are limited only by the wildest swing of their fancy in their efforts to create a vehicle of maximum carrying power at a minimum of cost, will eventually succeed in their purpose to the utter confusion and consternation of the paving engineer, who has about reached the fullest extent of his efficincy in road-building that the somewhat limited supply of those materials having certain inherent characteristics that make them valuable for road metals enables him to reach, unless some reasonable restriction is placed upon the design of these vehicles thereby terminating this unequal strife.

## No Excuse for Building Semi-Durable Pavements

"The use of the motor truck has exceeded all prophecies," said H. Eltinge Breed, First Deputy, New York Commission of Highways, in his last annual report. "The war has given it its place. It is a means of transportation coordinate with train and boat. Highways must be built to sustain it. In each of our three previous reports we have pleaded for the building of more durable types of pavement. We now have in this state 1,290 miles of durable pavement of the concrete, brick, asphalt block, etc., types, as distinguished from the less durable waterbound macadams, etc. Henceforth, except in unusually isolated communities, the durable type will be the *only* economical type. The higher first cost of the former will be offset in a very few years by the higher maintenance cost of the latter under heavy traffic. There is no further excuse for building semi-durable pavements in or near settled districts. Their 'cheapness' has, with the advent of the motor truck, become extravagance."

# Some Unusual Sewerage Problems and How They Were Solved at Ocean Beach, New York

*By Andrew J. Provost, Jr., Consulting Engineer, 39 West Thirty-eighth Street, New York City*

While nearly every sewerage system has in its design or construction at least one feature that distinguishes it in some respect, it is not often that the engineer is confronted with so many unusual and interesting problems as presented themselves in the Ocean Beach, N. Y., system constructed in 1916-1917 under the writer's plans and supervision.

### *Local Conditions*

The settlement, which is a purely summer colony, occupies a strip of beach between the Atlantic Ocean and Great South Bay, about 40 miles east of New York City. On the ocean side important sand dunes, some 20 to 25 feet in height, rise abruptly from the storm surf mark and form a natural barrier against inundation of the property at times of excessive tides. In all other portions the surface, which is fine alluvial sand, is substantially flat and, except where occasional secondary dunes occur, is only slightly elevated

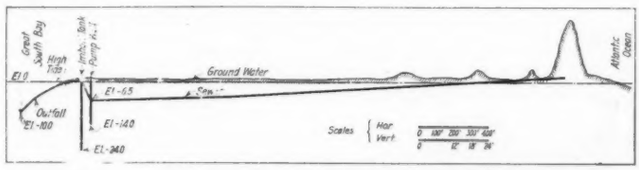



FIG. 1. PROFILE OF OUTFALL, MAIN TRUNK LINE SEWER AND TYPICAL LATERAL SEWER, OCEAN BEACH, NEW YORK.

above the high tide level. The mean tidal range in the ocean is about 4½ feet and in the bay about 15 inches. The ground water, which consists of a thin layer of fresh water of natural potable quality floating on a deep bed of salt water, is in almost all places within a few inches of the surface of the sand, and after heavy rains rises sufficiently to cover, for a period of several days, considerable areas of the surface. All buildings are elevated on posts or piers and cellars are entirely absent. Where the use of cesspools had been attempted they were a complete failure, and the employment of scavengers for the daily removal of the human wastes was quite as unsatisfactory.

### *Design Features*

When a system of sewerage was discussed, in 1915, it was promptly recognized that all the sewage must be pumped and that tidal disposal was necessary. It was also recognized that on account of the bathing beaches on both the ocean and bay water fronts, treatment of the sewage would be required to secure at all times a substantially sterile effluent. Careful consideration was given to the feasibility of constructing and maintaining an outfall sewer in the ocean, but, after a careful study of all such attempts made during the past 30 or 40 years at the New Jersey sea shore resorts this project was abandoned as impracticable. The problem was then reduced to constructing sanitary sewers in fine sand and water to a point where the sewage could be suitably treated and pumped into the waters of the bay. The general topographical and drainage conditions are shown in Fig. 1.

### *Influence of Ground Water on Design*

It was fully anticipated that great difficulties would present themselves in performing the necessary excavations, some of which would be more than 20 ft. below the ground water table and in fluid sand, and that, with the excavation problems disposed of, special precautions would be required to prevent excessive infiltration of ground water into the sewers through the joints and at manholes. The employment of cast iron sewers with lead joints, such as had previously been used by the writer with good results under similar conditions at Neponsit Beach, was recommended, in the deeper portions of the work, in the interest of future economical operation in the matter of pumping and treatment. In view of the immediate expense involved it was, however, decided to use vitrified clay pipes in 3 ft. lengths with bituminous joints in all cases where the pipes were laid below the ground water level. No limit regarding permissible infiltration was specified, but the contractor was obligated to to use all practicable precautions and measures to secure substantial tightness of the sewers and other structures. For the sedimentation tank and pump well, which required specially deep excavations into the water table, the contractor was given the option of constructing coffer-dams or of building these circular fero-concrete structures by sinking them in place as caissons. No water proofing was called for except the use of 10 lbs. of "Ceresit" compound in each cubic yard of concrete.

### *Construction of the Imhoff Tank*

The sedimentation tank, which is of the "Imhoff" type, was commenced by constructing a timber cutting-edge on the surface and loading thereon by means of inside and outside circular forms, an annular section of the exterior wall, complete with reinforcement, 4 ft. high. When the concrete had set sufficiently to permit releasing the forms, they were raised and another annular section was poured on top of the first. When the caisson had been constructed to a height about 12 feet above the surface, as shown in the accompanying photograph, Fig. 2, excavation was commenced on the inside by a bucket operated by a stiff leg derrick with gasoline engine drive. The hole was unwatered with a 3-in. centrifugal pump delivering about 350 gallons per minute. The structure settled evenly and without any trouble whatever and the wall was then completed in the manner described. The finished curb was level and within a fraction of an inch of the intended grade. Openings, temporarily closed with timber bulkheads, were cast in the wall to receive the proposed inlet and outlet connections.

When the contractor attempted completely to unwater the excavation for the purpose of laying the concrete floor, or bottom, it was found that the flow of sand could not be controlled or lowered below a point which, in the middle, was somewhat higher than the bottom of the cutting edge. This difficulty was finally overcome by allowing the excavation to refill with

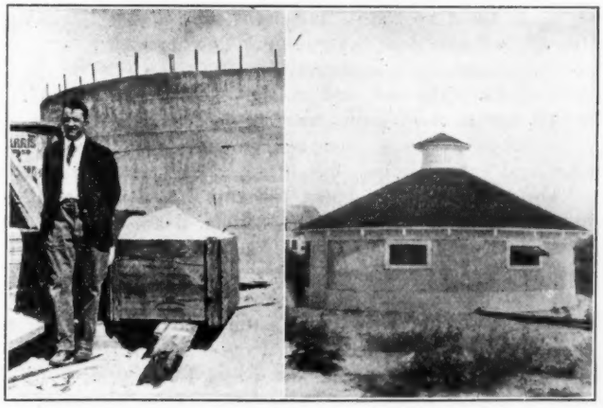


FIG. 2—PORTION OF CAISSON OF IMHOFF TANK BEFORE LOOSENING, OCEAN BEACH, N. Y. FIG. 3—VIEW OF SUPERSTRUCTURE OF IMHOFF TANK.

water and by removing the remaining excavation with an orange peel bucket working under water. With this balanced water pressure it was possible in this manner to remove the sand under the cutting edge and from all parts of the excavation so as to conform quite accurately with the proposed bottom which was an inverted truncated dome.

Concrete was then lowered through the water in a bottom-dumping bucket and deposited as evenly as possible to a depth of about 18 ins. Full length pieces of ¾ in. steel reinforcing bars were then lowered with ropes and adjusted in place with ends under cutting edge and spaced 6 in. centers in both directions. The remaining concrete was then deposited in the same manner. The bottom was completed Dec. 24, 1916, when the work was shut down for the winter. In March, 1917, the tank was unwatered and was found to be substantially tight under an outside water pressure of about 24 ft. The total leakage was, in fact, not more than ¼ gal. per minute, and most of this was traceable to the timber bulkheads.

The pump well caisson, which was 14 ft. in diameter and 15 ft. deep, was constructed in the same manner and with equally good results.

*Laying and Jointing Sewer Pipe*

The laying and jointing of the sewer pipes proved to be the most difficult problem of the entire work. The depth of these, where laid in saturated sand, varied from 2 to 7 ft. below the surface. The pipes were vitrified salt glazed tile in 3 ft. lengths with extra wide and deep sockets. Three lengths were jointed on the surface with "S. P. C. Pipe Seal Compound," a bituminous product prepared by the Standard Paint Company of New York City. These joints were poured at about 300 degrees F. temperature, with the pipes in a vertical position, as shown in the photograph, Fig. 5. The joints thus made could be rigidly inspected, and it is believed they were all of excellent character. The handling of these jointed sections while lowering them into place in the trench was carefully performed and no evidence was found to indicate that any of these joints were injured in this manner.

The trenches were sheathed in most cases with 3-in. tongue and grove timber, but it was found necessary to use steel sheeting for the deepest trenches. The work was not begun at the lowest point in the system, near the pump well, as strongly recommended by the engineer, but was attacked in various small sections, between adjacent manholes. The trench water was removed by diaphragm pumps driven by gasoline engines, supplemented in the deeper trenches, where the ground water was excessive, by a 3-in. centrifugal pump. Seaweed was used to caulk the leaks in sheeting and sod dams were used to control the continuous flow of water in the bottoms of the trenches. In spite of these precautions it was found impossible to lower the trench water much below the spring line of the pipe on account of the flow of sand with heavier pumping, and most of the trench joints were poured with the pipes at least half full of water.

No tests could be made for leakage until the entire system of sewers was completed and connected up, but each joint when poured was examined to ascertain that the jointing material extended throughout the entire circumference of the joint. Such joints as did not show this result were usually due to cooling of the compound before the joint was run and in all such cases the bitumen was removed while still plastic and the joint was rerun. Spurs for house connections were laid on average distances of about 40 ft. apart, and house connection branches were extended from these to an elevation above the ground water level in the manner shown in the accompanying illustration, Fig. 6.

*Manholes*

Manholes were constructed about 175 feet apart on the deeper lines. These were of concrete, 4 ft. square with 8-in. vertical walls covered by a 4-in. precast concrete slab with cast iron manhole ring and cover. Attempts made to pour the bottoms of these manholes in place failed, due to the cement being washed away by the water of infiltration, and it was found necessary to precast these bottoms on the surface and to lower them to place with claims operated with differential pulley blocks. With this procedure the manholes were successfully constructed and would, no doubt, have retained their positions if the contractor had planned his work to make all the connections to each manhole at one operation. Three separate connections were made in several instances, lasting over a period of a number of months, and, with the repeated removal of sand in pumping operations, several of the manholes settled from 2 to 4 or more inches, and in some cases probably ruptured the joints, if not the body, of the connecting piping. As this settlement was more or less uniform it had no serious effect upon the hydraulic gradient, but it did destroy many of the efforts made to secure a reasonably tight sewer system.

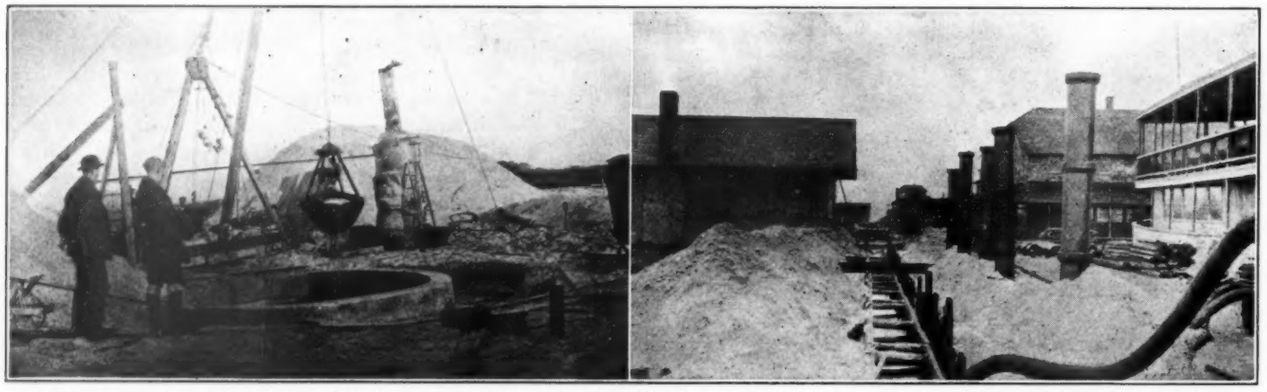


FIG. 4—PUMP WELL CAISSON IN FINAL POSITION REMOVING LAST EXCAVATED MATERIAL WITH ORANGE PEEL BUCKET WITHOUT UNWATERING CAISSON, OCEAN BEACH, N. Y., SEWERAGE WORKS. FIG. 5—VIEW SHOWS PROXIMITY OF MAIN SEWER TO TIDAL BASIN.

*Excessive Leakage in Sewer Lines*

As heretofore stated, no evidence of leakage in the deeper sewers could be secured prior to the completion and joining together of all the several sections of sewer which had been independently constructed. Upon such completion attempt was made to pump out the system with the pumping engines provided for permanent service, and which had a capacity of about 250 gals. per minute, but this capacity was insufficient to unwater the system. With the assistance of the construction pumps the pipes were completely emptied and the infiltration of ground water under this condition was estimated to be in excess of 300 gals. per minute, equivalent to more than 200,000 gals. per day, per mile of sewer, instead of about 30,000 gals. per day per mile, the amount contemplated when the system was designed. This leakage was declared unreasonable and the contractor was called upon to take such steps as necessary to abate the excessive infiltration. Without disclaiming responsibility the contractor contended he was unable to proceed and, acting under the advice of the engineer, the sewer commissioners undertook the work of repairs.

*Locating Leaks and Grouting Under Pressure*

Preliminary tests made with solutions of coloring matter (uranine) showed the principal leakage was confined to a continuous stretch of sewer about 1,200 ft. in length, representing the deepest section of the work. Estimates of the cost of excavating for and rejointing this line amounted to approximately $3,500. In view of this cost and of the necessity which existed for placing the system in service before such extensive work could possibly be performed, it was determined to experiment with cement grout forced with a pump into the sand in the vicinity of certain known defective joints. The method employed was to excavate a small hole, a few inches deep, over a joint and down to the normal ground

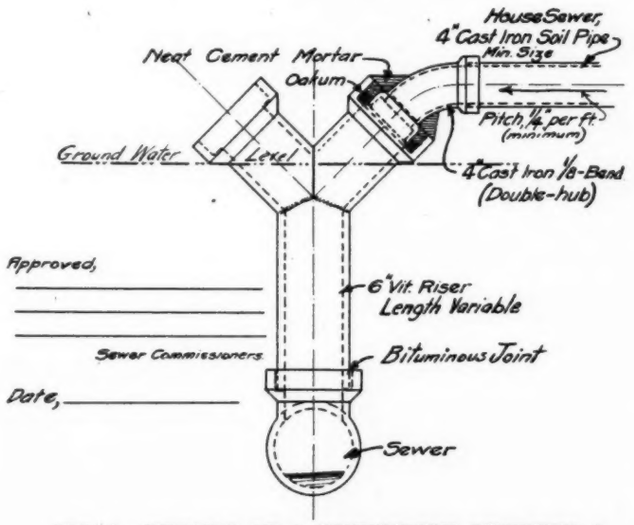



FIG. 6. DETAILS OF A CONNECTION BETWEEN A HOUSE SEWER AND A CONNECTION SPUR IN A STREET SEWER, OCEAN BEACH, N. Y.

This Design also Applies to Connection Spurs Without Risers.

water level. In this shallow pool a small amount of uranine was placed and, if upon starting the pumps the coloring matter was found at the nearest manhole, the joint was considered defective and grout was applied, through a nozzle attached to line of hose, below and around the joint until the color failed to show at the manhole. This test was quite rapid, since a very brief application of the grout was in most instances immediately followed by the absence of color in the stream flowing through the sewer.

This experimental work was continued for about 2½ days in the upper 250 ft. of the defective section and resulted in substantially stopping the infiltration of ground water in that section. One of the useful observations made during this experimental work was in demonstration of the extremely local influence of a defective joint upon the ground water level vertically above it. This was brought out by noting the depression of the ground water, which always existed over a defective joint when the drainage pumps were operating and also noting that as soon as the joint was made tight the water in the test hole above it immediately rose. This phenomenon suggested a plan for rapidly ascertaining the location of all defective joints in the remaining section and for eliminating the necessity of the color test. The application is shown in the upper part of Fig. 7, which is a profile of the ground water vertically above each trench poured joint while pumps were operating. This profile not only showed the location of each defective joint, but also the relative extent of the defect. Excessive depressions of the ground water such as existed at manholes A, B, C, E and F were assumed to represent ruptured or broken connections.

*Results of Grouting*

With this information a force of three men, one to mix grout and operate the hand pump, one to operate the nozzle and one to observe results and direct the work, completed grouting about 1,200 lin. ft. of sewer and ten manholes in two weeks, at a total cost of less than $300. This cost included the experimental work, the purchase price of force pump and hose, gasoline for drain pumps, cement and all labor except engineering supervision.

The only trouble encountered was with fractured pipes at manholes, where, in some cases, it was necessary to saturate the sand with grout for considerable distances from the break. In the cases of manholes B and C, it was at first found that, with nozzle applied close to the joint, the entire content of the grout barrel was siphoned by the flow of water into the sewer. In such case it was necessary to commence grouting at some distance away, and in this way gradually to shut off the flow of water before approaching the joint. The information furnished by the profile was found to be accurate, even to the extent of indicating the particular sides of manholes B and C, where ruptured pipes existed.

In the lower part of Fig. 7 is shown the profile of the ground water at the same points taken at the conclusion of the work when the tidal and pumping conditions were substantially the same as in the case of the first profile. In the absence of leakage, the ground water profile should be level and at about elevation zero, mean high tide. The final profile falls short of this and indicates clearly that the repairs performed were not entirely effective in preventing all leakage, which was the case. It does demonstrate fully, nevertheless, that the serious defects were substantially remedied and there was no doubt expressed at the end of the work as to the possibility of reducing the joint leakage to any desired minimum by continuing the work along the same lines. It was felt, however, that a reasonable result had been secured and that moderate distributed leakage, consistent with the pumping capacity available, was desirable in its result in slightly lower-

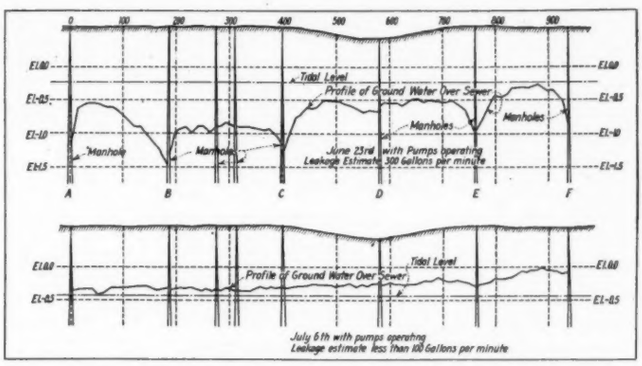



FIG. 7. DIAGRAM SHOWING EFFECT OF GROUTING AROUND JOINTS IN 1,200 LIN. FT. OF DEFECTIVE PIPE SEWER.

ing the ground water table, which, in some sections of the property, produced surface pools, particularly after rainfall.

*Bituminous Joints and Grouting*

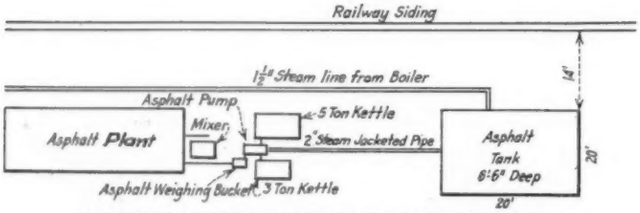
The writer must confess he has in the past been somewhat apprehensive regardiing the durability of bituminous compounds in sewer pipe joints, and has often felt the possible failure of these materials, after a few years contact with water and sewage, might prove decidedly unpleasant to those who now find their use so convenient. As the result of the experiences herein described he now feels the use of these materials, in water-bearing sandy soils, is entirely justified, since a rapid and economical method exists for repairing the joints, if excessive leakage should thereafter develop through disintegration of the bituminous compounds.

## How a Contractor Equipped His Asphalt Plant to Dispense with Two Men and Lower Cost of Asphalt

*By Morgan R. Butler, of Butler Construction Co., Waukesha, Wis., Temporary Address P. O. Box 237, Lansing, Mich.*

The Cummer Road Asphalt Plant, 1,250 cu. yds. capacity, is not equipped by the manufacturers with any mechanical means of handling asphalt. The asphalt must be bought in steel drums or wooden barrels and put into the melting kettles by hand labor. This usually requires two laborers to keep enough asphalt in the kettles.

In order to dispense with these two men, we installed a Kinney Pump with 2 in. suction and 1½ in. discharge; the pump, run by a 3 H. P. steam engine, was placed on a platform between the two kettles and convenient to the mixer. A concrete tank or cistern was built, as shown in the accompany-




A CONTRACTOR'S ASPHALT PLANT LAYOUT.

ing sketch, large enough to hold two tank cars of asphalt cement. Steam coils were placed in the bottom of the cistern to melt the asphalt. A 2 in. steam jacketed pipe was placed from the pump to the tank.

When tank cars were used, upon the arrival of the car, steam was turned into the coils of the car, and as soon as the asphalt was melted the car was drained by gravity into the tank, thus releasing the car in about twelve hours. When package asphalt was used, the staves or steel container were removed from the asphalt and the whole barrel rolled into the tank. Three men in about two hours time at night would put enough asphalt in the tank for a day's run of the plant. Valves and piping were arranged so that asphalt could be pumped from the storage tank to either kettle or from either kettle to the weighing bucket.

We figure by this arrangement we can eliminate two men and make a material saving in the cost of asphalt by buying it in tank cars instead of in packages.

## Experience of the New York Commission of Highways in Doing Its Own Construction Work on Unfinished Contracts

valuable functions of a State Board of Public Works, but the point here emphasized is that public water supplies should be

During 1918 the New York Commission of Highways concentrated their efforts upon the completion of roads already under contract. The department of construction took up the work on 15 cancelled contracts aggregating about 68 miles. Writing of the results of this work in his last annual report, former First Deputy H. Eltinge Breed said:

"The unusual success of the department in doing its own construction work upon these unfinished contracts, despite the interminable coils of legal red tape twined about it, raises the question whether it might not be advantageous for highway departments to be authorized and prepared in emergencies to do their own construction as well as engineering work. As in our own case, plants could be hired or gradually acquired, and contractors engaged as superintendents. The arguments pro and con are lengthy; the idea is advanced now simply because it is in accord with that spirit of the age which is tending to centralize authority and to unify responsibility."

*How the Work Was Handled*

Procedure on this work is described as follows by E. A. Bonney, Supervising Engineer:

"In carrying on this work a superintendent was procured who, as a first qualification, was a live, responsible contractor; who had not defaulted on any work with this Department; and whose record for integrity and business acumen in prosecuting his own work was unquestioned. He was placed upon a straight salary basis and a rental agreement executed for such plant as was necessary to properly carry on the work. Our plant rental prices are far below the going commercial rates and will stand comparison with rentals paid at any time and place.

"A representative from this department was placed upon the work as engineer and timekeeper, if it were possible for him to do both. On some of the larger contracts two men were needed. Wherever it was possible, the individual laborers, mechanics, teams, etc., were paid by individual check, after signing vouchers and payrolls for the amount due them. Payments of wages was made twice each month and to the lasting credit of the auditor's office, no employes were lost during the summer because of failure to receive their compensation on time.

"The rates for labor varied in different sections of the State from 30 cts. an hour to 45 cts. In no case was the rate paid by us in excess of that paid by individuals in the same section. The labor was generally scarce, hard to procure and inefficient, at least in comparision to five years ago. The laborer knew that he could get work whenever he wanted it and cared less and less about his job as the season wore on. It was a most trying and difficult problem for the men in charge. Nevertheless, as the season progressed, the State force contracts showed a larger average of work per contract than the work carried on by individuals. The rate of progress also exceeded the other contracts. This was partly due to the co-operation which we received from the Federal government in the procurement of cars to carry material, and possibly the preference shown us by the manufacturers of materials and owners of quarries because our credit as a purchaser was unassailable. This was particularly true in the matter of coal.

"The work in general was very satisfactory as to speed and quality. The costs were not excessive although we faced a handicap of comparison at the start because most of the contracts were taken as extremely low figures and the contract prices were far below the cost of present day work."

In closing, I will state that it is my belief that such work should not be carried on as a general practice. It places upon the Department entirely too great an amount of detail and too much personal responsibility upon the engineers and superintendents handling it. It has proved in the last two years that it is possible and feasible as a last resort for a commissioner of highways. It prevents him from having his hands tied by wilfully obstructive tactics of a surety company as evidenced in the past by their bidding in completion work at prices far below cost after which no work would be started; and provides the citizens of our State with relief when ordinary methods of procedure fail. When kept down to a minimum and used only in the extremity, the system has proved its value.

## The Design and Construction of Bituminous Macadam Roads and Pavements

*By A. W. Dean, Chief Engineer, Massachusetts Highway Commission, Room 212 State House, Boston, Mass.*

A bituminous macadam pavement is one having a wearing course of macadam with the interstices filled by a penetration method with a bituminous binder.

Such pavements were built in a rather crude manner in England and France in the early part of the nineteenth century, but were nowhere extensively built until little more than

ten years ago, when the change in vehicular traffic and consequent, increased destruction of waterbound macadam pavements made necessary the construction of a surface to withstand the new destructive forces on the roads. In the United States the year 1908 marks the real beginning of this type of pavement, although a few small experiments or attempts were made previously. The first results achieved, while at the time appearing successful, were not durably satisfactory, due to the fact that improper materials and workmanship were used. Further experimental construction and careful observation of results obtained by varying the character of material and method used have resulted in a widespread use of this type of pavement at the present time, and when properly constructed it has proved to be an economical type where the vehicles to be propelled over it are not extremely heavy.

*Drainage and Foundations*

In the construction of this pavement, as in that of any so-called permanent type, proper drainage and foundations are absolutely essential. Moisture and frost action under the road crust are just as destructive as in the cheapest or most expensive pavements.

If the subsoil is a gravel or suitable sand, no artificial foundation may be necessary, but if of clay or other improper material, a foundation course consisting of stone or coarse gravel should be placed. If of stone, the interstices should be thoroughly filled with gravel to prevent the clay subsoil from gradually working up and filling the voids in the stone, thereby permitting the moisture to permeate and destroy the foundation and pavement during frost action.

*The First Course*

Upon the properly prepared natural or artificial foundation the first course of broken stone should be spread evenly and to sufficient depth to be of the desired thickness after rolling. No universal rule can be made covering the thickness of this course, as the local conditions vary so extensively. For example, in some localities, the subsoil is of such nature, and the materials available in the immediate vicinity are of such nature, that an artificial foundation of stone 10 ins. or more in depth may be laid and the first course of the pavement need be only about 2 ins. in thickness. This is economical and satisfactory in localities where suitable stone for foundation is plentiful, but stone suitable for the first course of the macadam has to be imported at considerable expense. On the other hand, if the subgrade is a proper one so that artificial foundation is not necessarily used, the first or bottom course of the macadam should be not less than 4 ins. in thickness after rolling, and, if heavy loads are to be sustained, a thickness of 6 ins. is desirable.

The stone in this course should be of uniform and good quality, and should be spread in such manner that there may be no segregation of large or small stone. The stones composing this course may vary in size from ½ in. to 3 ins., in their longest dimensions, provided, however, that the percentage of the small size shall be very small. If the course is 4 ins. or less in thickness, the best results are obtained, however, by using stone varying in size from 1¼ to 2½ ins. The same minimum size is preferable in a 6 in. course, but the maximum size may then be 3 ins.

In laying this course the same methods should be used as in the laying of ordinary waterbound macadam, including thorough compaction by rolling, and securing a uniformly smooth surface. Unlike the first course in waterbound macadam, however, the voids in this first course must be filled with stone dust, fine gravel, or sand, in order to prevent wasting of bitumen by penetration into this course during the construction of the top course. It is essential that the surface of the bottom course be even and without depressions before laying the top course. After the construction of this course is completed, all surplus dust and fine material should be swept off, leaving the upper stones bare to receive the second or bituminous course.

*The Second Course*

After the completion of the first course as above set forth, the second course is spread at such thickness that it will be 2 ins. thick after rolling, if for medium or light vehicular traffic, or 3 ins. thick if for heavy vehicles in large volume.

It is extremely important that the stone used in this course be of good quality, uniform in character, and so spread that there is no segregation of large or small sized stones. If building for light-weight vehicles only, the stone used may have a French coefficient of wear as low as eight and a hardness value of eight, but for heavy vehicles a better quality of stone should be obtained if possible, using in such case a stone having a French co-efficient of not less than twelve, and preferably even greater, and a correspondingly higher hardness value.

*Sizes of Stone*

The best and most lasting results are obtained if the sizes of the stone in this course vary from ¾ in. to 2½ ins., with the larger sizes predominating. This has been proven, even though it appears inconsistent to use a 2½ in. stone in a course 2 ins. thick.

Extreme care should be had in the laying and rolling of this course to have it uniform in its component sizes of stone and rolled to a uniform thickness. The rolling should be thorough, in order to reduce the voids and make the surface hard and smooth, although not as thorough as in the case of waterbound macadam roads.

*Applying Bituminous Material*

After rolling, the bituminous material should be applied at a temperature of 250° to 300°F., with a mechanical distributor that will force the material onto the surface uniformly, such force being equivalent to that obtained under a pressure of 30 lbs. or more to the square inch. The amount of bituminous material used per square yard in this application will vary from 1½ gals. on a 2 in. course to about 2½ gals. on a 3 in. surface. Great care must be had in the distribution of the bitumen to prevent getting too much or too little material in spots or streaks, otherwise "bunches" or depressions, as the fault may cause, will soon develop.

After spreading the bitumen, it should be lightly but completely covered with pea stone (½ in. stone) and thoroughly rolled, using a 15-ton roller, if available, and if the stone is of hard quality, and a somewhat lighter roller if of a poorer quality stone. Success will not be obtained if this course is not thoroughly rolled.

A seal coat of the same quality of bitumen is then applied, using one-half gal. of bitumen to the square yard for this application, then covering again with pea stone and finishing with the heavy roller.

When the bitumen is applied the stone should not be wet, but may be moist, and in all cases must be absolutely clean and free from dust. The bitumen used may be an asphalt or tar product, and as this paper is somewhat limited, the details of specifications for this material are necessarily omitted.

*The Bitumen*

Whether of asphalt or tar, the bitumen should be properly refined and prepared for use in this type of construction, its properties varying slightly with the climatic condition of the territory in which it is to be used.

In northern climates like that in the New England States and lower Canada, the best and most lasting results appear to be obtained by using an asphalt having a penetration of 90 to 110, as determined by the standard method of testing adopted by the American Society for Testing Materials.

The United States Department of Agriculture has published a bulletin (No. 691), giving specifications somewhat in detail for bituminous materials of different kinds and for different uses, which bulletin is available for distribution. Reference is here made to that pamphlet for more details, but the writer believes from experience and observation that for penetration work in northern climates the asphaltic material

should be a little heavier than that suggested in those specifications.

Where properly built under suitable climatic and traffic conditions, the bituminous macadam pavement is economical both in construction and maintenance. If a hole appears in the surface it should immediately be patched, using a mixture of small stones and hot asphalt or tar. If a general breaking of the top surface appears imminent, it should be given a seal coat of hot asphalt and pea stone before such breaking up occurs.

*Rules For Prevention of Unsatisfactory Results*

A few condensed rules are here given for the prevention of unsatisfactory results with bituminous macadam:

Be sure that the drainage, subgrade and foundations are suitable.

Have the surface of the bottom course even and without depressions before laying the top course.

Have the larger sizes of broken stone predominate in the top course.

Use dumping platforms or self-spreading wagons for spreading all broken stone.

Use a sufficiently hard bitumen for both penetration and seal coat, as a soft material permits the surface soon to become wavy.

Get all penetration work complete during the spring and summer months. If done in the late fall the penetration is not complete and the pavement is liable to become loose in the following winter.

Patch holes immediately if they appear in the surface.

If tar is used, apply a light seal coat at intervals of two or three years.

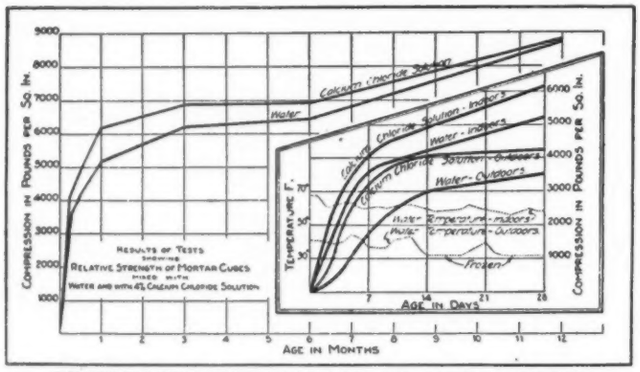
*Acknowledgement*

The foregoing paper was presented at the Sixth Canadian Good Roads Congress.

## Advantages in Use of Calcium Chloride Solution to Hasten the Setting of Cement Concrete

A series of tests were completed in 1918, by the New York Commission of Highways to determine the advantages in the use of calcuim chloride solution to hasten the setting of cement concrete. The results of these tests are described as follows by H. Eltinge Breed, formerly First Deputy Department of Construction in his annual report:

"It has been stated that by use of this solution concrete gun foundations could be put in use three days after construction. The tests made by this department were for the purpose of determining whether the rapid setting would decrease the ultimate strength which the concrete would attain. It is well known that abnormally quick setting cements do not usually make concrete which is as strong ultimately as the slower setting cements.


Compression in Pounds per Sq. In.
Age in Months
Water
Calcium Chloride Solution
Results of Tests showing Relative Strength of Mortar Cubes mixed with Water and with 4% Calcium Chloride Solution
Temperature F.
Age in Days
Water - Indoors
Water - Outdoors
Water - Temperature - Indoors
Water - Temperature - Outdoors
Frozen

RESULTS OF TESTS SHOWING RELATIVE STRENGTH OF MORTAR CUBES MIXED WITH WATER AND WITH 4 PER CENT. CALCIUM CHLORIDE SOLUTION.

Laboratory test samples were prepared and tested at ages varying from one day to one year. The results are shown graphically herewith. They indicate that the use of a four per cent solution of calcium chloride as mixing water for cement concrete increases the strength attained at all ages up to one year. Beyond that is still problematical, but what evidence we have indicates certainly no deterioration, and a probable continued, but slower, gain. The maximum increase appears to be about 20 per cent at the age of one month.

The importance of this determination will be appreciated when it is considered that by the use of this solution it will be possible not only for the contractor but also for the public to make use of cement concrete pavements a few days after they have been laid without risk of damage. It will mean the completion of much work in the autumn which has hitherto had to wait over unfinished until spring.

## Highway Requirements for Twentieth Century Transportation. with Special Reference to New Jersey Practice

*By Wm. G. Thompson, State Highway Engineer, Trenton, New Jersey, in Address to National Highway Traffic Association*

So many different factors enter into consideration of this subject that it is difficult to state and classify them in the order of their relative importance. The first factor is traffic—present and future.

*Traffic Uncertainties*

For what weight and size of vehicle must the highway of tomorrow be constructed? Next comes future volume of traffic, which can not be estimated with any degree of accuracy, since, prior to 1912 no really widespread movement for construction of high-class pavements in the rural or interurban districts was noticeable, further that paving of roads in any particular locality increases not only the number of motor vehicles owned in that locality, but the use of its roads by foreign cars, whose owners are ever seeking new routes for business and pleasure. Therefore, we can hardly venture a prediction as to the increase in volume during the next fifteen years. It would seem, then, that our design can be influenced only by an arbitrary estimate or determination of future needs as to the widths of pavements in order to obviate congestion. The same is true as to thickness or depth of foundation, since there is no precedent to guide design, because no pavement has heretofore been designed to carry a specific loading. Here again enter variables, such as impact at varying speeds and loads and varying sub-foundation conditions.

*Specific Data Lacking*

The Bureau of Public Roads in Washington is now making tests to determine the extent and effect of impact on pavements. These tests, extensively conducted on each type of modern pavement and covering varying foundation conditions, should prove of great value to the highway engineers of the country.

Lacking specific data, and precedent, highway engineers are now making use of the best types known today, such as Portland cement concrete and brick, stone block and asphaltic concrete on concrete foundation, and hope they will last for 15 or 20 years. Since I am more familiar with conditions in New Jersey, I will outline what is now being done on the state highway system there in an earnest effort to provide for the future traffic, highways which shall be smooth and convenient to motor traffic at all times of the year.

*Alignment, Grades and Width.*

On all state highways, the graded width or carriageway from gutter to gutter will be not less than 30 ft. In the open country we are going to considerable expense to secure curves not sharper than 6 degrees, and grades not exceeding 5 per cent. All curves sharper than 5 degrees are being super-

elevated or banked, there being a gradual transition from the straightaway to the curved section. This method has already proven its value as an aid to easy riding, since there is no perceptible strain or overturning motion while rounding the curves so treated.

*Drainage*

Particular attention is being given to sub-foundation drainage, upon the adequacy of which the integrity of the pavement depends in marked degree. It is believed that expense incurred on this factor, before the pavement is laid, is justified because the pavement may be rebuilt or rejuvenated from time to time without entire removal to correct drainage conditions which should have been cared for during the initial construction. On long flat stretches storm sewers are being built with catch basins to carry off surface water which would not flow in flat grade side ditches or gutters.

*Pavements*

Hard pavements will be not less than 18 ft. wide. In addition there will be 3 ft. stone shoulders on each side, making in effect, 24 ft. pavements. There will then be 3 ft. earth or gravel shoulders, making a total of 30 ft. of carriage or travelled way. On the main, heavily travelled routes are being laid concrete pavements 8 ins. thick at the sides and 10½ ins. thick at the center. On the secondary routes are being laid concrete pavements 6 ins. thick at the sides and 8½ ins. thick at the center. Where asphaltic, brick or stone block pavements are used they will have concrete foundations not less than 6 ins. thick, except that in the more isolated sections, where traffic will not be heavy for many years, asphaltic pavements will be laid upon existing macadam bases, where such exist of proper width and depth. None of the state highways will be paved with macadam or bituminous macadam, or any other material inferior to asphalt or concrete.

A sincere effort is being made to build for the highway traffic demands of tomorrow. In alignment, width, grade and pavement, the view point is that we are building for a long time to come and the best obtainable, within reasonable financial limits, should be had now. In the Engineering News Record for May 8 is found this question: "Why are such revolutionary changes necessary in pavements which have given satisfactory service on heavy traffic city streets heretofore?" It seems to me there are several good reasons for the building of city pavements on interurban and country highways. In the first place, city streets, until the past three years, were never subjected to the test to which they are now, and will hereafter be subjected, and it remains to be proven that present city pavements will stand the new strain. We can all remember when no vehicle using New York streets travelled at a greater speed than four or five miles per hour. Heavy horse-drawn trucks downtown moved three or four miles per hour. Now, motor trucks with the same and heavier loads travel 15 or 20 miles per hour. On rough pavements the impact and destructive forces are, therefore, now many times greater, notwithstanding the change to solid rubber tires. If these things be true in crowded city streets, will they not be more true on country highways, where, when city restrictions as to speed no longer hold, every class of motor vehicle increases its speed to 25 or 30 miles per hour. I am convinced that if speed alone were to be considered, it will be necessary to build stronger pavements on interurban highways than on city streets, especially in New Jersey, where, because of its many industries, the motor trucking between cities is very heavy today. Tomorrow will but bring a greater volume and density.

The drainage factor also requires that heavier pavement foundations be built on interurban highways. City streets are usually paved from curb to curb. They are underlaid by sewers, pipe lines, conduits, etc., all of which conduce to good sub-foundation drainage, while surface water runs to the gutters and is quickly carried away by the sewers. In the country and especially in cuts, there are springs, the menace of which it is difficult to remove. Water from open ditches and hillsides seeps into and under the foundation. In wet weather the foundation is softened. In cold weather, the saturated foundation freezes and expands, heaving the pavement and often breaks the surface. Considering the destructive effect of impact at high speed, and of inadequate drainage, and the relative effect of these two factors on city pavements, it is believed justification exists for building heavier pavements in the country than in the cities.

*Bridges*

Our state highway bridges are being designed and built for a loading of 20 tons, it being assumed that 75 per cent. of the vehicle load will be on the rear axle. Under bridges spanning the highways, vertical clearance will be not less than 14 ft. from pavement to under side of girder.

*Grade Crossings—Railroad*

Railroad grade crossings are being eliminated wherever and as rapidly as practicable. In one instance of a section of the state highway now under construction, the relocation of the highway to parallel the railroad will do away with eight grade crossings within four miles; this includes the parallel tracks of two different railway systems.

*Signs*

A comprehensive system of road signs is being installed to indicate direction, distance, dangerous crossings, curves and grades. These will be substantial, having concrete posts, and the inscriptions so designed and worded as to enable the motorist to proceed with the least inconvenience and loss of time.

Observing the singular lack of markers to enable motorists to proceed through city streets while en route from one city to another, and to reach the trunk highway quickly, we are marking the street corners with a distinctive sign, which will enable tourists to pass from the state highway entering the city, through the widest streets in the most direct manner possible, to the state highway leaving the city. At present there are few corners on through routes in large cities so marked as to expedite movement of through traffic.

In order that there shall be no unpaved sections through small cities and towns on the state highways, the state will pave at its expense through all municipalities having a population under 12,000. With municipalities having a population exceeding 12,000, the state may enter and is now entering into agreement with such cities, by which each shall pay a portion of the cost. In many of the smaller communities the town authorities are paving from the state pavement to the curb. The routes of all state highways are so designated or laid out as to enter the large cities through their widest streets, so through traffic will not have to use the narrow, congested city streets. The county engineers of New Jersey, with the state highway department, have adopted a standard system of marking so all highways under county control will be thoroughly posted in the same manner as the state highways. These facts are cited, simply to show that the coming needs are fully realized, and earnest effort is being made to provide for them.

*Present Highway Requirements*

Briefly stated, highway requirements for the 20th century transportation as we see them are the following: Ample funds, good alignment with flat curves and low grades; adequate sub-foundation drainage, the widest, strongest, toughest pavements obtainable; where they enter large cities paved widths should be several feet wider than in open country. Bridges designed for at least 20 ton loads, few or no railroad grade crossings; a comprehensive, thorough system of marking for distance, direction, and dangerous conditions; and a system of reasonable and enforced traffic laws which will protect all motorists, yet permit the expeditious movement of traffic.

The state highway commission has published and is now circulating an official map of the state highways, showing all state and county roads, indicating sections of routes under construction, and printed data concerning detours, to enable motorists to avoid most conveniently the construction work. This

map and information will be revised from year to year as the work proceeds, so as to be always up to date.

This paper was supposed to deal with what are considered to be the highway requirements necessary for the 20th century; in setting forth herein what New Jersey is doing, I am but reflecting the ideas of its highway commission, which is trying to foresee the requirements and is building accordingly. It realizes that in many localities the pavements should be wider, but is building the best its finances will permit, confidently believing that the system, when completed along present lines, will prove so satisfactory that the public will provide additional funds for extensions and improvements.

## How Albany, N. Y., Saved Over $360,000 in Using Re-Dressed Granite Paving Blocks

*By Frank R. Lanagan, City Engineer, Albany, New York*

### *The Problem*

The old granite block pavements in Albany, N. Y., have been a veritable gold mine in the extensive repaving operations undertaken by the city. In the era before motor vehicles, most of the streets of any appreciable grade were paved with dimension granite blocks on a 14-in. foundation of block or river sand. Due to cuts, frost action and years of wear, the old granite block pavements became uneven and unsatisfactory for the rapidly growing use of modern motor vehicles and the problem was how to repave or pave practically all the streets in the business section and provide surfaces which would be satisfactory for both horsedrawn and motor vehicles, particularly on the grades.

### *A Successful Experiment*

In 1911 an experiment in repaving was tried on a short narrow street with a grade of about nine per cent. and subject to heavy traffic. The old granite blocks were taken up, cut in half and redressed and paved with grouted joints on a new 6-in. concrete foundation. The resulting surface was uniform, smooth, perhaps a little too smooth to give horses a good foothold, easily kept clean and not noisy from traffic.

As a result of this experiment, it was decided to use similarly the old granite blocks on practically all of the business streets of heavy traffic. There were some exceptions, as for instance, using asphalt on one street on a slight grade that previously had had granite, storing the granite and later using it after cutting and re-dressing on a street that previously had had vitrified block.

### *The Re-dressed Blocks*

The average dimensions of the old granite block were 3½ ins. wide, 7½ ins. deep and 11 ins. long. The specifications for the broken and re-dressed granite required that each old block of sufficient size and quality should be broken and re-dressed to obtain fair, true and approximately rectangular surfaces on the top and sides, the dimensions to be not less than 6 ins. in length, from 3½ to 4½ ins. in width, and not less than 5 nor more than 6 ins. in depth. Due to culls, a small deficiency of blocks resulted from paving equivalent areas. The city, however, supplied blocks to make up the deficiency from its storage pile, the contractor doing the necessary carting and handling. The workmen who did the cutting or breaking and re-dressing of the block became very expert in the number they could prepare in a day. They were paid 1 ct. per new block cut and re-dressed at first, but later the price was increased to 2 cts.

### *Laying the Re-dressed Blocks*

The re-dressed blocks with the new faces up and with end and side joints not exceeding ¾ in. were laid on a 1½ in. sand cushion over a 6-in. foundation of 1-3-6 concrete. The joints were grouted with a 1 to 1 grout. At first pea-stone was used partially to fill a portion of the joints and to hold the blocks in position while paving and ramming were in progress, but it was found that the grout did not penetrate through the pea-stone to the cushion and in consequence under particularly heavy traffic the blocks became loose, so the specifications were modified and the pea-stone omitted.

### *Grouting*

In grouting the joints, it seemed to be practically impossible so to squeegee the surface that the grout would not also cover the top of the pavement. This is to the disadvantage of horses on the grades particularly in bad weather.

On one block, it was necessary to return after the street had been opened to traffic and score the joints with cold

VIEW OF REDRESSED GRANITE BLOCK PAVEMENT ON STATE ST., ALBANY, N. Y.

chisels using power from a portable air-compressor. The city has now, on grades of 6 per cent. or more, adopted the practice of relaying the old granite blocks without breaking and re-dressing, on a minimum sand cushion over a concrete foundation, grouting the joints but raking them before the cement has hardened. This gives a uniform surface perfectly satisfactory for motor vehicles and at the same time affording a good foothold for horses on the worn and rounded surfaces of the old granite.

### *Cost Data*

Following are the quantities and the average prices per square yard for dressed granite blocks and for re-dressed granite block pavements on a 6-in. concrete foundation from 1913 to 1918. The price per square yard for the dressed granite block pavement includes the displacement excavation, the foundation, sand cushion, new blocks, grouting, etc., complete, and the price per square yard for the re-dressed granite block includes everything as above except the blocks, the old granite being taken up, the blocks cut, re-dressed and reused.

| | New Dressed Granite Block Pavement | | Cut and Re-dressed Granite Blk. Pavement | |
|---|---|---|---|---|
| | Sq. yds. | Aver. price | Sq. yds. | Aver. price |
| 1913 | 1,852 | $3.55 | 16,919 | $2.29 |
| 1914 | 9,833 | 3.44 | 48,220 | 2.36 |
| 1915 | 12 309 | 3.22 | 199,556 | 2.18 |
| 1916 | 39,404 | 3.23 | 44,442 | 2.09 |
| 1917 | 1,501 | 3.79 | 18,199 | 2.26 |
| 1918 | 27,871 | 4.33 | 425 | 2.62 |

As may be figured from the above, the saving to the city through having and refusing the old granite blocks, thus avoiding the expense of new dressed granite blocks was over $360,000.

## Considerations Affecting the Choice of Road Machinery

*By Arthur H. Blanchard, Consulting Highway Engineer, Broadway and 117th St., New York City, in Address to Sixth Canadian Good Roads Congress.*

The high wages of unskilled labor in 1917, 1918 and 1919 and the uncertain status of the labor supply of the future has resulted in a thorough analysis of highway construction data to determine economical methods of using road machinery. The trend of wages of unskilled labor was ably covered in the 1919 report of the committee on "Unskilled Supply" of the American Road Builders' Association, wherein it was stated that the average rate per hour in the United States in 1912, was 19 cts; in 1913, 20 cts; in 1914, 20.5 cts; in 1915, 22.5 cts; in 1916, 26 cts.; in 1917, 30 cts.; and in 1918, 39 cts.

*Demand for Labor Saving Machinery Increases.*

In the opinion of the writer, American highway officials must face high wages for unskilled labor for several years. The basic economic law of supply and demand naturally applies to labor conditions. It is not probable that the war shortage of unskilled labor will be changed over night. It is not logical to expect that unskilled labor, which entered the service will rush back to the pick and shovel after demobilization. Emigration records show that thousands of laborers are leaving America every month. Immigration, the usual source of supply of unskilled labor, is an unknown quantity and agitation in the United States for restricted immigration further complicates the situation. It is not surprising, therefore, that the reconstruction period finds highway officials, engineers and contractors investigating all types of labor saving machinery.

*Factors Influencing Selection of Equipment*

The selection of equipment for the construction and maintenance of highways should be based upon a consideration of the following factors: (1) character of work; (2) specification requirements covering plant equipment; (3) amount of work; (4) portability of plant; (5) large and small units; (6) ease of manipulation; (7) adaptability to different classes of work; (8) funds available; (9) depreciation of plant; (10) transportation facilities. The practical necessity for the consideration of many of the above factors is self-evident.

*Character of Work*

In the case of contractors whose work is confined to the construction of sheet asphalt pavements and in the case of a department such as, for instance, that of Wayne County, Michigan, where the highway work consists primarily of grading operations and the construction of cement concrete pavements, the problem is materially simplified. On the other hand where a contractor's work covers the construction of all the various types of roads and pavements used in a municipality, county or state, the selection of the several units of plant equipment should be based upon their adaptability to different classes of work. For example, where cement concrete pavements as well as concrete foundations are to be constructed, in many cases a type of mixer should be purchased which is satisfactory for the construction of pavements, the requirements for which are more specific than in the case of mixers used only on foundation work.

*Specification Requirements Covering Plant Equipment*

In the modern practice of highway engineering, many specifications include stipulations which must be met by machines and accessories employed. As illustrations might be cited the weight of rollers, pressure limitations in distributors, grouting apparatus, and details of mixers for the manufacture of bituminous concrete.

*Amount of Work, Portability of Plant, Large and Small Units*

It is evident that a contractor for a department will be justified in the purchasing of an ideal equipment if the work is to be extensive in character. If the work is centralized and large in amount, as in the case of sheet asphalt work, in many municipalities a large, well equipped permanent plant will prove economical. If, on the other hand, the work is large in amount but distributed over considerable area, small portable units will prove more satisfactory, as in the case of mixing plants for the manufacture of bituminous concrete to be laid on provincial highways.

*Ease of Manipulation*

In cases where contractors are engaged in general highway work and their organization does not include foremen who are specialists in the manipulation of various types of complicated machinery, it is of utmost importance that simplicity of machines and ease of manipulation should be given great weight in the selection of equipment. This is particularly true in connection with various types of machines used in the construction of bituminous surfaces, bituminous macadam and bituminous concrete pavements.

*Adaptability to Different Classes of Work.*

It is well known that specifications for different classes of work, requiring the same type of machine, call for differences in detail. For grading work, specifications might require rollers weighing from 12 to 15 tons, while in the construction of wearing courses of some types of pavements, a 10 to 12-ton roller is stipulated. A contractor who is handling a small amount of general highway work would, therefore, find it advantageous to purchase a 12-ton roller suitable for both classes of work mentioned above.

*Funds Available*

Departments and contractors are necessarily forced to consider first cost of equipment, as the funds available may not permit the installation of the most economical and efficient machines. In many cases where such conditions are encountered, it is obvious that it will not be practicable to anticipate that the work can be accomplished with the same degree of rapidity and at the same cost as if more efficient machinery constituted the plant equipment.

*Depreciation of Plant Equipment*

Depreciation charges on plant equipment should be given careful consideration prior to the purchases of machines and accessories as well as in the consideration of the cost of highway work.

*Transportation Facilities*

Facilities for the transportation of machinery and materials materially affect the efficiency of the several units of plant equipment. For example, in municipalities and provinces where materials may be transported over highways in good condition, the use of the motor truck will usually be found desirable.

*Plant Equipment Suitable for Grading, Quarrying, Construction and Snow Removal*

Brief consideration will be given to the plant equipment suitable for grading, quarrying, construction of the several types of roads and pavements, and snow removal. It is also evident that normal conditions usually will be assumed as the basis for suggestion of plant equipment for the various items of highway work enumerated.

*Transportation Equipment*

Motor trucks and wagons usually will be found a necessary part of the equipment for all classes of highway work. Tractors and trailers are proving of particular value on long haul work where loading and unloading apparatus require motor trucks to remain idle during several hours a day. Industrial railroads have proven efficient equipment on highway work where a large tonnage is to be handled quickly on long hauls.

*Grading*

Grading operations vary from the scarifying of an old road surface, preparatory to the construction of a new wearing

course, to heavy cut and fill work requiring the moving of thousands of cubic yards of material. It is apparent that only extreme conditions can be mentioned in this discussion as the economics of the utilization of various classes of machines on average grading work would necessitate a comprehensive discussion. For the lightest class of grading mentioned, scarifiers drawn by rollers have proved more economical and efficient than the use of picks in roller wheels or any one of the several types of plows drawn by rollers or tractors. For the heaviest class of grading work, in many instances steam shovels loading into wagons will be found economical. In connection with all grading work except light scarifying, one or more of the following types of machines should form a part of the plant equipment for grading: Road drags, grading and rooter plows, drag, buck and wheel scrapers, elevating graders, and rollers. It should be noted that the utilization of the elevating grader has not been fully developed by many contractors.

There are on the market many types of steam and gasoline traction engines suitable for hauling grading machinery. For many classes of grading work, their use is more economical than the employment of horses and mules. Essential features which should be based by a contractor for grading work are as follows: (1) sufficient power for hauling the several types of grading machines under the variety of conditions on which it is expected to be used; (2) adequate mechanical strength; (3) simple mechanism enabling it to be easily steered, controlled and otherwise operated; (4) driving wheels of large diameter and of such width as to enable the tractor to operate efficiently on soft ground.

*Quarrying*

Plant equipment for quarrying depends primarily upon the kind of rock, the required output per day, and the length of time during which the quarry will be worked. Drills and blasting devices are a necessary part of all equipment for rock work. Contractors or departments working the quarry to supply material for a specific highway would use the ordinary portable crushing and screening plant consisting of boiler, engine, jaw crusher, elevator, screen and bins. Small quarries, more or less continuously operated, are generally equipped with the above plant except that in many cases the gyratory crusher proves more economical. Passing to the largest quarries, modern equipment for the economical manufacture of broken stone should consist of steam shovels for removing the rock masses for the quarry face to steel cars. In such quarries the pieces of rock transported to the crusher may vary in size up to masses weighing 7 or 8 tons. The rock should be first crushed in a mammoth jaw crusher from which the rock should be passed through a series of gyratory crushers, jaw crushers and rolling mills and thence to elevators, screens and bins. In some plants of this type washing devices are a necessary part of the equipment in order to produce stone chips free from dust.

*Earth Roads*

In the construction of earth roads on a large scale, the following equipment has been found to be economically efficient: Elevating grader drawn by horses or by a tractor, scrapers, disc and straight-tooth harrows, road drags, rollers and watering carts. The combinations of the machines mentioned which will be used will depend upon the amount of work, character of the soil and the cross section to which the road is to be built.

*Gravel Roads*

Spike-tooth harrows, scrapers, road drags, rollers and watering carts constitute the equipment for the construction of gravel roads. Many engineers and contractors have found grooved rollers more satisfactory for this class of work than smooth faced rollers.

*Broken Stone Roads*

The average equipment consists of harrows, rollers, and watering carts. For many types of construction and kinds of rock, rolling for long periods with 10 or 12-ton rollers has secured a better compaction and economical bond than in cases where 15 and 18-ton rollers have been used for short periods. Some contractors have found automatic screening spreaders a valuable addition to the plant equipment.

*Bituminous Surfaces*

The equipment required for the construction of bituminous surfaces depends upon the amount and character of the work and the rapidity with which it must be accomplished. For example, the construction of a bituminous surface on a broken stone road will require an equipment of rotary brushes or coarse fiber brooms, bass fiber brooms, in some cases batteries of heating kettles, a distributor to meet specifications and adaptable for the distribution of the kind of bituminous material under conditions stipulated in the specifications, pouring cans, squeegees, and, in some cases, 5 to 10-ton rollers and hand-drawn or horse-drawn automatic stone chip distributors.

*Bituminous Macadam Pavements*

The equipment will depend primarily upon the specifications and the kind of bituminous material employed. The usual equipment consists of batteries of heating kettles, a distributor, pouring cans, and a roller. The specifications covering certain features of the distributor may be specific, as in the case of the 1918 specifications adopted by the American Society of Municipal Improvements herewith quoted:

"The pressure distributor employed shall be so designated and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than 20 lbs. nor more than 75 lbs. per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than 6 ft. and so that it will be possible on either side of the machine to apply widths of not more than 2 ft. The distributor shall be provided with wheels having tires each of which shall not be less than 18 ins. in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a 2 ft. diameter wheel, 250 lbs. shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of 20 lbs. per inch being allowed for each additional 3 ins. in diameter."

*Bituminous Concrete Pavements*

The type of pavement, amount of work, the specifications and the kind of bituminous material employed materially affect the selection of the plant equipment for this class of work, Batteries of heating kettles and a roller are required for the construction of all types of bituminous concretes. Although the practice of contractors has varied to a considerable extent with reference to the weight and type of roller, many now favor the 10 to 12-ton tandem roller for all classes with the exception of Topeka Bituminous concrete. Plants of many types have been successfully employed in the manufacture of bituminous concretes. Naturally the most economical and efficient work has been accomplished by a plant especially adapted for mixing the type of aggregate used. Generally, on highway work outside of urban districts, the portable plant proves most satisfactory. Dependent upon the plant accessories, the aggregate is measured by volume or weight before being dried or by weight after drying, the latter being preferable. The aggregate is usually dumped into bucket elevators, which discharge into rotary driers. In the best types of plants, the heated aggregate is then raised by bucket elevators and discharged into a small storage bin. As desired, the heated aggregate is drawn from the storage bin and allowed to fall directly into the pug mill mixer or, preferably, first into a weigh-

ing box. The bituminous cement is weighed in scales on the mixing platform and then dumped into the mixer. After thorough mixing, the bituminous concrete is usually discharged into a wagon or truck, which the plant arrangement permits to be placed directly beneath the mixer. For pavements of the type of bitulithic, a rotary screen is a necessary adjunct to the plant. For those types of bituminous concrete in connection with which seal coats are employed, the equipment will necessarily be increased by the addition of hand-drawn distributors, pouring cans, squeegees. and, in many cases, hand-drawn automatic stone chip distributors.

*Sheet Ashphalt Pavements*

The plant equipment necessarily depends upon the amount and location of the work and the specifications. A tandem roller constitutes a part of the equipment for all sheet asphalt work. The mixing plants are of three types, portable, semi-portable, and permanent. A complete plant includes a cold sand elevator, a drier, a hot sand elevator, a hot sand storage bin with screen, an asphalt elevator, a flux tank, melting tank, draw-off tank, a sand measuring box, a dust elevator, bin and measuring box, an asphalt cement bucket and a pug mill mixer.

*Cement Concrete Pavements*

Variations in economical equipment depend primarily upon the specifications. A beam and bucket cement concrete mixer, forms, screeds, bridges, belts, long handled light rollers, watering carts, pumps and hose usually constitute the equipment for the construction of cement concrete pavements constructed by mixing method.

The essential features of a plant are covered by the following excerpts from a report of a committee of the National Conference on Concrete Road Building: "The concrete mixer should be of the batch type provided with an automatic water tank, traction drive and power loader. Mixers having a boom and bottom-dump bucket of sufficient size to convey one complete batch for placing the mixed concrete are preferred. Where necessary to keep from cutting into the subgrade and to facilitate moving, the wheels of the mixer should be run on suitable planking. The mixer should be provided with a suitable automatic water tank which can be quickly filled and emptied, so that when once determined, the required amount of water can be added to each batch of concrete. The power loader or skip should be of sufficient size to hold all the materials required for the batch.

*Wood Block Pavements*

For the building of wood block pavements, the equipment should include the necessary apparatus for the construction of the mortar cushion, or a template and hand roller when a sand cushion is employed, a tandem roller weighing from 3 to 5 tons and the necessary distributing apparatus for the application of fillers and the construction of expansion joints.

*Brick Pavements*

The equipment should include a wood template and hand roller for the construction of the sand cushion, a double metal template for constructing a mortar bed on a green concrete foundation, a tandem roller weighing from 3 to 5 tons, brushes, cement grout boxes or a small mixer if a cement grout filler is employed, or conical pouring cans if bituminous fillers are used for the construction of transverse or longitudinal joints.

*Stone Block Pavements*

The equipment includes, in some cases, templates and hand rollers for the construction of the sand cushion, tampers and the necessary apparatus for filling the joints.

*Snow Removal*

Equipment for snow removal is affected by the amount of snow in a storm, the yardage and location of the roads to be cleared. For highways outside of urban districts, road scrapers and horse-drawn and motor plows have been found economical and efficient. In the case of many roads, compaction of the snow being principally required, snow rollers constitute the equipment.

## The Advantages of the Cost-Plus-A-Fixed-Fee Contract for Building Construction.

*By A. E. Wells, President Wells Brothers Construction Co., 914 Monadnock Bldg., Chicago, Ill.*

The last decade has seen the rise and fall of many building contractors, large and small. The cause, in the majority of cases, lies in the fact that the contractor is expected to build not only according to specifications and within the time limit, but to gamble that his cost will come within a fixed contract price notwithstanding the variables such as the forces of nature and the conditions of labor. Therefore, failures are many.

*The Old, Gambling Contract.*

Most business men will agree that it is not within the province of the contractor to gamble. He is retained as an expert to assemble materials into a finished whole. It is not difficult for an able concern to finance itself for this work but if in addition it must carry insurance for owner that it will perform within a definite contract price, the financing is more difficult.

In competitive bids, the cost of this insurance is paid generally by the low bidder out of profits, or, as frequently happens, out of his capital, for the reason that he is more likely to get the contract as he scales down his allowance for contingencies. A competitive bid which includes a safe allowance for insurance against contingencies was seldom low under pre-war competitive conditions. The inevitable results were the bankruptcy of the contractor and an additional cost to owner or the surety company to complete the unfinished contract.

*The Owner's Viewpoint*

It is apparent, however, that an owner feels more sure if he is able to know, in advance, closely what a certain project will cost. A careful estimate, made by a reliable contractor and checked by the owner's architect and engineer, is certain to be more satisfactory than a competitive bid in which the result may show only which contractor is willing to take the longest chance against the possibility of costs higher than estimated. A bank, for instance, may issue certain bonds for a power house and if the cost runs above their total, additional financing is necessary. This should be avoided, and yet, why should the contractor be asked to underwrite the accident of greater cost?

*War Time Test Proves Merit of Cost-Plus Contracts.*

At the Chicago meeting of the Associated General Contractors of America, Nov. 21, 1918, this topic was thoroughly discussed and Brigadier-General R. C. Marshall, Jr., Chief of Construction Division, War Department, U. S. A., pointed out clearly the fault of the usual pre-war basis of contract. He showed the impossibility on recent War Department work of asking for competitive bids, because speed was the essence and detailed plans and specifications were never complete at the time when construction must start. On such work it was therefore out of the question for a contractor to bid on a flat contract price basis. It would have been fair to neither side. There was developed, therefore, a form of contract known as the Cost-plus-a-sliding-scale-fee contract.

General Marshall stated that early in the spring of 1918, the program of work before the Construction Division was so extensive that it seemed advisable to have the merits of this form of contract again passed upon, and a committee of eminent business men unqualifiedly endorsed this form of contract in General Marshall's own words at the convention of general contractors:

> "No contractor should be called upon or permitted to undertake the performance of any contract that within the four corners of the paper upon which it appears is, or may be written the financial bankruptcy of the contractor. It is unjust, it is inequitable, it is uneconomic. The great lesson

of this war on the subject of the relationship, between the contractor and the owner is the cost-plus contract. This represents the only equitable basis under which a contractor may perform constructive and economic services for the owner. It is the only form of contract which affords protection to both parties. To me, all the energies, the thought and the experience of this country within its own continental lines during the past year and one-half of this world struggle shall have been in vain unless out of it shall grow, as a permanent institution, solidifying the economic relationship between the contractor and owner, the cost-plus contract."

My Company has built extensively under both forms of contract and our most satisfactory work, both to owner and to ourselves, has been on the cost-plus basis. For such concerns as Montgomery Ward & Co., The William Davies Company, Limited, Toronto, The Robert Simpson Company, Limited, Toronto, and Butler Brothers, Chicago, we have operated on this plan, have been able to start construction work much sooner than would otherwise have been possible and therefore given early occupancy. Almost without exception we have made savings for the owner below the preliminary estimate of cost.

*Don't Forget Interest During Construction*

The fact that money tied up during construction earns nothing, makes quick construction attractive in practically all fields of building. When we are given the opportunity to work with the owner, architect and engineer at the very inception of plans and to begin foundations as soon as the general contour of the building and equipment are determined upon, we are able to give the owner a service which is impossible under the lump sum price contract, as this requires the long delay necessary for the completion of plans and the taking of competitive bids, all of which may be extremely costly to the owners.

But we do not believe that the cost-plus fixed fee basis of contract is applicable only to work where speed is the first essential. In the years to come it will doubtless prove to be the most equitable basis for all classes of construction and upon that basis our company is now operating. The owner properly reaps the benefit of any saving which may be made below the estimate, thru the combined and co-operative effiort of owner, architect, engineer and contractor.

The major manufacturing operations are conducted upon this plan. The Ingersoll dollar watch is now a thing of the past. While that watch "Made the dollar famous," it now retails for considerably more because of conditions beyond the control of the maker. That watch is now made on a cost-plus fixed fee basis, if you please, for the price is going up with the cost of manufacturing.

In the field of the automobile we do not find manufacturers gambling with a fixed price. From season to season, costs vary and selling prices follow.

That the contractor, supposedly an expert in building matters, should be called upon to absorb the risk entailed in any form of contract other than that based upon cost-plus fixed fee is to me unbusniesslike, unfair and unAmerican.

War conditions furnished the opportunity and the necessity for testing out more generally than ever before this form of cost-plus-fixed-fee contract and results prove that the great majority of the building industry met the test adequately and honorably. Post-war reconstrution conditions will be met to the best advantage to both owner and contractor if the cost-plus-a-fixed-fee contract is generally used.

## The Engineer in Politics—How Far Will the American Association of Engineers Go in Politics?

*By W. A. Stinchcomb, County Engineer, Cuyahoga County, Cleveland, Ohio, in Address to Annual Convention, American Association of Engineers*

Let me make myself clear in the use of the word "politics." I do not refer to it in its partisan sense, but I do most decidedly refer to it in a civic or governmental sense.

*The Duty of the Engineer to Enter Politics*

To say that the A. A. E. and its members shall not go into politics would be to deny to the country and the local communities within which it has chapters the service of an organization of men who, by natural ability, by education, by training and experience are most capable of serving the public and in directing and educating the voters on questions of public policy, and would deny to its members the fulfillment of their obligations as citizens of this Republic.

Now I know that a natural tendency exists among engineers not to take an active part in politics, but by so doing they evade their full responsibilities as citizens. Will any one say that the engineer's training and experience do not better fit him to solve the problems of government as our civilization becomes more complex, than one trained in any of the other great professions?

*Some Political Problems Stated*

What are some of these political problems?

In our cities practically all of our public problems are subject to scientific analysis. Is the subject one of developing the physical plan of the city, including the adequacy and location of its highways, the kind and strength of its pavements, the development of its park and recreation facilities, the working out of a proper drainage or the planning of its transportation facilities, either rail or water? Surely the engineer is best qualified to solve such problems. He is now called on for advice in these matters, and in my opinion he should be largely the one to decide.

In matters of public health as influenced by problems of sanitation such as sewage and garbage disposal, water supply and building and housing regulations, he is best qualified.

On questions affecting the control of public utilities such as transportation, electric or gas supply and telephone service, his engineering training best fits him to bargain with the trained mind representing the public utility companies, and to know when the contract has been made that justice is done both the public and the service corporation.

As cities extend further into the realm of municipal ownership of these public utilities, his obligations to serve the public in an executive capacity in directing the management of such work increases and his fitness to serve grows.

Even in the welfare and social problems of the city his analytical training fits him to search out the cause of our social evils and ills—to relieve them rather than apply only palliative and preventive measures.

Will any one say that he is less qualified to organize and direct the ordinary housekeeping affairs of a city because of his training and experience?

*The Engineer Should Take Dominant Part in Politics*

One of the most difficult and always present problems of all government is that of financing and taxation. It is the constant duty of the engineer in his practice so to design, execute and organize his work that the cost will be as low as possible. All problems of public taxation must go back to a proper appraisal of the property taxed whether that property be in a tangible or intangible form. Here again his experience and training fit him well to serve efficiently.

Our national governmental problems are best solved when the engineering mind influences their solution.

And so in my opinion the engineer should take a dominant part in politics, and this association as an organization should wield a forceful influence in determining the civic and governmental policies—not as a right only, but as an obligation which both the engineer and the association owe to society.

*Political Activity Beneficial to the Association*

"But," I hear some timid soul say, "what effect will that action have on the engineer and this association?" In my opinion it cannot be anything but beneficial.

This convention has had its attention called to the inadequacy of the salaries paid engineers in public services. Various means will be discussed as to methods by which salaries may be properly and equitably increased. How better can this be done than that the members of this profession shall take an active interest in the political question of their communities?

We have noted the appointment of men neither fitted by education nor training to take charge of departments of public service which really require the services of the trained engineer. We have seen the engineer subordinated to such superiors. He has seemingly been content to let his "light shine under a bushel," and have the accomplishments of his brain and energy appropriated by those to whom they do not rightly belong. By a more active participation in politics these injustices would be removed and credit bestowed where it rightfully belongs.

*What Other Professional Men Do*

We have seen national organizations of other professions jealously guarding the business interests of the members of their professions. There is the National Bar Association, the various national organizations of the medical fraternity, whose efforts are used not only in maintaining a proper code of ethics in the profession, but in seeing that the members of that profession as a body are not discriminated against by the passage or operation of what they consider to be unjust laws. And so in halls of legislatures their representatives are seen when measures affecting those professions are under discussion—and the professions referred to do not have to do with the public work of the state in any degree compared with that of the engineer.

It has always seemed to me that the engineer himself has been to blame for the position in which he is held by society and for the meagerness of the salaries paid by both public and private corporations for his services. He has been retiring in his nature, content to too large a degree to take his reward from the satisfaction growing out of difficult problems well solved and difficult work well performed.

*Engineers Must Speak Up for Themselves*

I recognize the fact that there are certain kinds of professional advertising which are distasteful, but I know that you cannot expect to have the public place a proper estimate on the value of a profession unless that profession itself as an organized unit holds it up to a high standard of value. This in a large measure can be accomplished by a proper indulgence by the engineer in the political problems and discussions of the day.

We cannot in a democracy expect to maintain our government for any length of time in advance of the intelligence of the voters. The intelligence of the voter is only expressed through the polls, and is influenced by the kind of political education which the voter receives. In elevating the standard of citizenship the engineer can and should be a leader in his community. To be anything less not only results generally to the disadvantage of the individual but decidedly to the disadvantage of his profession, and is a direct evasion of the responsibilities of citizenship which his training and ability impose upon him.

Therefore, in my opinion the members of this organization and the organization itself should take an active part in politics in the sense in which the word has been used. They and it should become leaders in moulding public opinion in a manner free from partisan political bias.

## Three City Engineers Discuss the Movement Calculated to Improve the Employment Conditions of All Engineers in Public Service

To the Editor: With reference to engineers in public service and plans that may be made for bettering their conditions of employment and compensation:

It is a too common idea that an engineer in public service has his position as a result of some kind of "pull" and that he has not necessarily been selected for his position because of fitness for it. Unfortunately, also, there are too many cases existing today where this idea is not far wrong.

This condition can be remedied to some extent by an organization, fostered by engineers, which will make recommendations for the general good of the profession to the appointing powers and having these recommendations based upon the merits in each case. The organization should then stand behind such recommendations. I do not mean a political organization in the general acceptance of the term, but merely an educational organization intended to bring to proper attention the facts in each instance, and backed by sufficient membership to assure these recommendations serious consideration.

Efforts could also be directed toward a campaign for placing executive engineering service under civil service and making it impossible to remove these heads merely because of a change in the political appointing power. Subordinate positions selected from lists passing so-called examinations should be filled by those who can really satisfy the requirements for the position. The writer was recently requested for a list of civil service examination questions for various positions in a municipal engineering force. The list was made up and was not as techncal as it should have been. However, the comment on the list was that "the fellows cannot pass that. They would have to have some engineering knowledge." Salaries should be placed at a figure that would not make it desirable for men to leave municipal employ for private employ on account of better compensation for like work. At the same time, the men should do the same amount of work for the corporation that is requested of them by private employers.

I believe that the only way, under existing conditions, that the above results can be in a measure accomplished, is by an organized publicity effort on the part of those familiar with the requirements and duties of various engineering positions, reasonable recommendations as to salaries, etc., and sufficient publicity to make it apparent to the appointing powers that these recommendations are for the best good of the general public. Anything that the American Association of Engineers can do along this line will be a step toward the betterment of the profession.

Very truly yours,
HARRY C. McCLURE.
Commissioner of Engineering and Construction.
Dayton, Ohio, June 9, 1919.

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To the Editor: Relative to the movement calculated to improve the employment conditions of all engineers in public service:

This is a subject which I think has given engineers in public service, especially those who are at the head of public service organizations, something to think about, especially during the past seven or eight months. I am frank to confess that this subject has taken about as much of my time during this period as the administration and supervision of the work which we have undertaken and has caused me no little concern.

I am in sympathy with any movement developing the interests of municipal and county engineers or engineers in any particular line of work and I think the American Association of Engineers is doing a great service to the men in the engineering profession. When we begin to discuss the subject of bettering conditions of engineers we do not want to let our minds run in the one channel, that being the increase of compensation. My feeling in this matter has always been that men in the engineering profession should devote a portion of their time to promoting the non-technical interests of the engineers in public service. By this I mean that engineers should take a greater interest in politics as described in the

address of W. H. Stinchcomb at the recent annual convention of the American Association of Engineers (published in this issue of Municipal and County Engineering). In his address Mr. Stinchcomb says, "Let me make myself clear in the use of the word 'politics.' I do not refer to it in its partisan sense, but I do most decidedly refer to it in a civil or a governmental sense." I know there has been little tendency for engineers to take an active part in public affairs but the sooner engineers in public work appreciate the fact that they should be the leaders in questions of public interest so much the sooner will the public begin to appreciate their service and the compensation will come as a natural reward. Therefore, I believe that when engineers become leaders in molding public opinion in a manner free from partisan politics, they reap rewards in the way of better salaries.

Very truly yours,
E. A. ZIESLOFT.
Akron, Ohio, June 9, 1919. City Civil Engineer.

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To the Editor: The subject of compensation for civil engineers is a very live one and deserves active attention from the profession, and especially from that division known as municipal engineers.

In the public's mind engineering covers a multiplicity of services which overlap in their functions to such an extent as to be confusing. There is need, therefore, to classify engineering service into several large groups which can be distinguished readily by the nature of the service rendered. In this grouping subsidiary forms of service must be ignored and only the main branches emphasized. Only in this way can the general public get a comprehensive view of the great field of engineering.

The subsidiary functions are matters of concern, not to the public, but to the profession.

The professional standing of engineers with the public is largely the fault of the engineers themselves. We have no quarrel with the public. Too often we have sat back after solving the knotty problems of civilization and the comfort troubles of humanity, content with the feeling of a needed work well done as our reward. This is a peculiar psychology. The two-fisted, red-blooded, he-men that opened the way to civilization, provided the vehicle for its movement, stayed with it while it moved and served it in its final luxury, are now content with the crumbs from the table—the most practical men failing to achieve a practical result to themselves personally.

Perhaps this has been due to a false and silly standard of ethics. Perhaps we have had the false pride that disdains to talk of filthy lucre in the face of the accomplishments wrought, but we can make the public appreciate the profession only by making them pay a commensurate price for the service rendered.

The question is how to make them pay. On that point, I believe that salesmanship of an idea is the true solution and salesmanship in its broadest and most far-reaching effects is dependent upon publicity.

Engineering must be visualized by an intense campaign of education. The great public does not know, except in a hazy, indefinite manner, that from the mapping of the first Indian trail to the erection of the last skyscraper that the engineer has been the genius that has made possible this present civilization.

Every community needs to know how engineering is intimately connected with its very existence. Municipal engineers receive passing thought and sometimes recognition when Pete Smith's sewer is blocked, and his cellar is flooded, or John Jones can't get his flivver up a mud street.

When the public thoroughly understands what engineering means to humanity, I am optimist enough to believe that the idea of adequate compensation will be sold.

This is the permanent way. I can't help but feel that the arbitrary fixing of prices, while it may afford immediate relief, only places the profession in a trades-union class, with the public's criticism of this method of fixing compensation. I believe that the public once convinced will gladly pay the price.

There are ample reasons on the grounds of increased living costs for an increased schedule of compensation immediately, and that should be on a bonus system determined by the percentage rise in cost of living since, say in 1914. That is, if for this month the increased cost above 1914 prices for standard living commodities is 45 per cent. then a bonus of 45 per cent. on this months' salary should be paid the employee. If next month it is 33 per cent, then the bonus will be 33 per cent. of the month's salary. That would solve the present problem for the salaried man and would give time for building the solid foundations of publicity and salesmanship of service on which to erect a permanent schedule.

We need time to classify the profession, define qualifications for each class, get the protection of a proper license law either Federal or State, establish a surveillance of proposed laws affecting the profession, initiate new legislation, and finally to fix the minimum compensation for each service and to ostracise the man who cuts under.

Very truly yours,
E. A. FISHER.
Lakewood, Ohio, June 9, 1919. City Engineer.

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## How the American Association of Engineers Aided Engineers in St. Louis Municipal Service in Effort to Improve Their Condition

*Contributed by an Engineer in Public Service in the City of St. Louis*

Very much to the point of the leading editorial in the May issue of "Municipal and County Engineering" is the history of the effort of the Saint Louis City Engineers to improve their condition.

### *Employes on Efficiency Basis*

The City of Saint Louis, in accordance with the Charter of 1914, has adopted an efficiency system for all city employes. Under this system, all grades of city services have been classified, duties defined, and salaries fixed. This classification went into effect in the spring of 1918, and the salaries fixed did not make full allowance for what was then considered high pay on account of the war. At a later date, when the securing of employes in all grades became more difficult, a supplemental ordinance was passed which added to the salaries specified the folowing percentages: Salaries up to and including $100, 15 per cent.; $100 to $150, 10 per cent.; $150 to $175, 5 per cent. Substantially, these percentages are still effective and are in addition to the rates mentioned later.

### *Effect of War Conditions*

During the latter part of 1918 and the spring of 1919, the city lost many of its best engineers and draughtsmen through competition of more highly paid services. It had already contributed a large proportion to the military service, and this second defection very seriously affected both the number and efficiency of the organization.

The efficiency board was not able to keep up any certified list for appointment, and it became necessary for the department and division heads to find the men and induce them to apply for positions, in many cases requesting appointments in a grade higher than that indicated by the duties in order to secure services. About mid-winter the competition of the railroads for engineering services became exceptionally keen. A number of men were lost, and a number of promotions were authorized in order to hold others. It was also found that there was a serious unrest among the men remaining, and that the quality of the work was being further affected. For this reason, the department heads were thoroughly con-

PRESENT AND PROPOSED SALARY SCALES FOR ENGINEERS IN THE SERVICE OF THE CITY OF ST. LOUIS, MO.

| Symbol | Duties of position | Present Scale | Proposed Scale | Railroad Scale |
|---|---|---|---|---|
| | **Engineer Group** | | | |
| PE I | Junior Professional Engineers—<br>Civil, Mechanical, Electrical<br>Junior Professional Engineering Draftsmen—<br>Civil, Mechanical, Electrical, Architectural | 90, 100, 110 | 125, 130, 135, 140, 145 | 135-170 |
| PE II | Assistant Professional Engineers—<br>Civil, Mechanical, Electrical<br>Assistant Professional Engineering Draftsmen—<br>Civil, Mechanical, Electrical, Architectural | 125, 135, 145 | 150, 160, 170, 180, 190 | 170-215 |
| PE III | Professional Engineers and Architects—<br>Civil, Mechanical and Electrical<br>Professional Engineering Draftsmen—<br>Civil, Mechanical, Electrical | 150, 160, 170, 180, 190 | 200, 210, 220, 230, 240 | 220-250 |
| PE IV | Senior Professional Civil Engineers<br>Senior Professional Mechanical Engineers<br>Senior Professional Electrical Engineers<br>Senior Professional Architects | 200, 210, 220, 230, 240 | 250, 260, 270, 280, 290 | 300 |
| PE V | Chief Professional Civil Engineers<br>Chief Professional Mechanical Engineers<br>Chief Professional Electrical Engineers<br>Chief Professional Architects | 275, 285, 295, 300 | 325, 335, 345, 355, 365 | 400 |
| PE VI | Division Engineers (Civil, Mechanical, Electrical) | 4,000 per annum | 5,000 per annum | 5,000 |
| | **Draftsman Group** | | | |
| SPD I | Sub Professional—<br>Draftsmen (Beginners)<br>Blue Print Operators | 70, 75, 80, 80, 85 | 80, 85, 90 | 100-125 |
| SPD II | Sub Professional—<br>Draftsmen (Tracers) | 90, 95, 100, 100, 105 | 100, 105, 110, 115 | 125-135 |
| SPD III | Sub Professional—<br>Draftsmen | 115, 120, 125, 125, 130 | 125, 130, 135, 140, 145 | 135-170 |
| | **Engineering Assistant Group** | | | |
| SPEG III | Chief Gauge Reader | No present schedule | 110, 115, 120, 125 | No Classification |
| SPEI II | Instrument Men | 90, 95, 100, 100, 105 | 95, 105, 115 | 100-125 |
| SPER I | Rodmen | 70, 75, 80, 80, 85 | 80, 85, 90 | No. Classification |
| SPES III | Surveyors | 115, 125, 135, 145 | 125, 140, 150 | 135-170 |
| | **Miscellaneous** | | | |
| V M O | Assessment Ordinance Draftsman | 2100, 2220, 2340, 2340, 2560 | 2100, 2250, 2400, 2550, 2700 | 230-250 |
| V M R | Right of Way Agent | 140, 145, 150 | 150, 160, 170 | 210 |
| ISt B III | Chief Inspector of Bituminous Paving Materials | 125, 135, 145, 145, 150 | 175, 185, 195, 205, 215 | No. Classification |
| PCE III | Engineer in Charge Municipal Testing Laboratory | 185, 195, 205, 205, 210 | 200, 210, 220, 230, 240 | 225 |
| IC III | Superintendent of Construction (all Municipal Buildings) and Maintenance of Streets | 150, 160, 170, 185, 200 | 200, 210, 220, 230, 240 | 225 |
| I PD II | Designer of Plumbing and Sanitation | 150, 160, 170, 175 | 175, 185, 195, 205, 215 | 170-250 |

vinced of the inadequacy of the rates paid for engineering services, and were ready to recommend a general revision.

Under the complications surrounding efficiency service, such a revision was not easy to carry out, and though suggested on several occasions, it appeared in March, 1919, that nothing would be accomplished.

Under the present standardization ordinance governing efficiency services, revision of salary schedules must be recommended to the Board of Aldermen by the Efficiency Board at the time of the passage of the Annual Budget Bill, generally about the second week in April.

*The Local Chapter of the A. A. E. Gets Action*

During March, members of the Saint Louis Chapter of the American Association of Engineers had canvassed municipal employes to some extent, but it had secured comparatively few members. In talking this over with one of the division heads, it was suggested to the committee that the municipal engineers felt that the A. A. E. was a railroad engineers' organization, and that it had little to offer them. The committee immediately countered by asking whether there was anything they could do, and on learning the details surrounding the standardization and classification of employes, volunteered to take the matter up with the Efficiency Board from the viewpoint of the employe. A conference was arranged, and a committee of railroad engineers spent a whole afternoon outlining conditions of engineering employment to the chairman and chief examiner of the Efficiency Board, and convinced these officials that the city schedule was too low to permit of maintaining a satisfactory organization. The officials informed the committee that they would recommend a revision and proceeded to outline the revision, which the committee felt was insufficient, but which it endorsed, after careful investigation of conditions had made it apparent that greater demands might spell disaster to the whole campaign. The schedule agreed upon affected six grades of engineers, including engineering draughtsmen, three grades of sub-professional draughtsmen, surveyors, instrument men, rodman, and seven special positions. The present scale and the proposed scale are shown in the accompanying tabulation.

*They Call on His Honor, the Mayor*

A meeting of municipal engineers and draughtsmen was called by the officers of the A. A. E., and a committee of the City Engineers was appointed to act with the officers of the local chapter of the A. A. E., in handling the campaign for revision. This committee called upon the mayor, who advised them that he favored payment of the prevailing scale to all classes of city employes, and that if the Efficiency Board would present a new scale for engineers and draughtsmen, with their recommendation, he would approve it. The matter was then presented to the City Comptroller, and it is understood that that official called into conference a member of the engineering profession who happened to be employed by the city in a consulting capacity, and that this engineer advised the comptroller that with the exception of about three grades, which should be modified somewhat, the demands were absurd, not in line with prevailing salaries, and that he could secure all the men necessary at the existing rates. On the basis of this testimony, it is understood that the comptroller agreed to this minor modification, and announced himself as being entirely and utterly opposed to the revision of the scale as a whole.

*Two City Officials, One an Engineer, Oppose Engineers*

It is understood that another city official also was opposed to the revision and is supposed to have taken the attitude that "engineers as a body take so little interest in civic and political affairs as to warrant little consideration from the administration." Whatever the personal views of these officials may have been, it developed on April 14th that the Efficiency Board had recommended to the Board of Estimate the revision of salaries previously agreed upon, that the mayor again announced himself as favoring the revision, but the Board of Estimate refused to accept it, and made only the minor changes mentioned above.

*Engineers Turn to A. A. E.*

Convinced by this occurrence of the necessity for organization, the engineers and draughtsmen and allied employes of the city services immediately applied for admission to the A. A. E., almost in a body. They were organized into a Municipal Section of the Saint Louis chapter. They proceeded to draw a new ordinance providing for the same revision of the engineering scale, with the addition of a few other special positions, and introduced this ordinance into the Board of Aldermen. They presented their proposal to the Associated Engineering Societies of Saint Louis, and after investigation by the joint council of that body, it was unanimously endorsed by the meeting of May 14, thus giving the schedule the backing of 1,200 organized engineers of the city. The city organization has since been further welded together by the admission of the Saint Louis chapter of the A. A. E. into the Associated Engineering Societies of Saint Louis, thus increasing the membership of the associated societies from nine to twelve hundred. The municipal section has appointed a legislative committee, which is organizing the city technical employes, in order to obtain recognition in each ward, and a publicity committee which is attempting to advertise the engineering profession locally.

The ordinance introduced by the municipal section and known as Board Bill No. 56 of the Board of Aldermen, has had its second reading, and is in the ways and means committee of that body. There seems to be little doubt that the engineers have convinced the aldermen of the advisability of action, but the real test will come when the bill again appears before the board of estimate for approval. It will then be seen whether the city officials who formerly voted against it have been convinced of the political importance of the technical employes on the one hand, and of the folly of accepting the views of a single engineer in such matters, when opposed by the unanimous endorsement of the profession.

The Saint Louis question has become more than a local one, in that the Saint Louis schedule was reported to the National Convention of the A. A. E., on May 13th, at Chicago, Illinois, and while criticised by many delegates as setting too low values was eventually endorsed as a satisfactory schedule for municipal services by that body.

## Some Broader Aspects of Rain Intensities in Relation to Storm Sewer Design

*By Robert E. Horton, Hydraulic Engineer, 57 N. Pine Ave., Albany, N. Y.*

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*Introduction*

While the subject of rain intensity in relation to storm sewer design is a highly specialized matter of technique, likely to interest designing engineers more than municipal officials in general, yet there are certain broader aspects of the subject hitherto little considered, which may not only interest engineers, but others as well.

In view of the large number and diversity of rain intensity formulas which have been developed and the differences among them, for apparently similar conditions, and sometimes for the same stations, the writer took up the question of making a general study and comparison of rain intensity formulas and data readily available, with a view to determining what, if any, general relations might be found to exist between rain intensity and the various factors of a meteorologic nature to which it is related, and whether or not any general form or type of rain intensity formula could be developed.

At the request of the editor of Municipal and County Engineering, some of the results of these investigations, and the conclusions thus far reached, are here presented in brief form. It is impossible within the scope of this article to present the details of the studies upon which some of the conclusions have been based. Some details illustrating special methods of analysis of rain intensity data used by the writer, however, will be presented.

The subject of rain intensity has heretofore been considered mainly in relation to local conditions, and the treatment of the subject has been by purely statistical and empirical methods. In this article some effort will be made to trace out the underlying physical and meteorological causes which produce and control the phenomena of excessive rainfall.

*Definitions*

The terms "rainfall rate" and "rainfall intensity" are often used as equivalent. It would be preferable to limit the use of the word "rate" to cases where the time involved is some well-established unit used in measuring velocity, such as the hour, or day, whereas the word "intensity" may be applied to the amount during any specified time interval. One may speak of a "rainfall rate" of 3 ins. an hour, which is equivalent to an intensity of 0.5 in. in 10 minutes, 1 in. in 20 minutes, etc.

Ordinary curves of excessive rainfall used in storm sewer

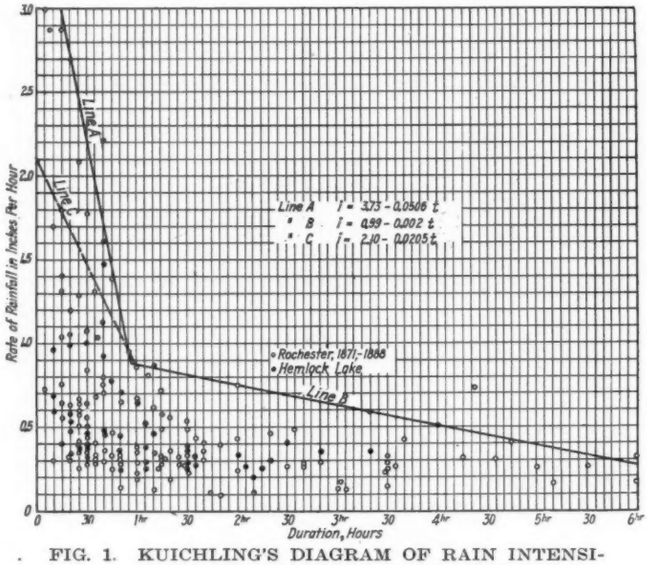



FIG. 1. KUICHLING'S DIAGRAM OF RAIN INTENSITIES AT ROCHESTER, N. Y., 1889.

design express the quantity for a given time interval in terms of the equivalent amount in inches per hour. There are, therefore, really rainfall rate curves, although they are quite generally called rain intensity curves, the amount in inches per hour corresponding to a given intensity and time commonly being expressed by the letter "I." It seems necessary to continue this usage, because it is well established, and because such curves are in reality used to determine the intensity of rainfall for a chosen time interval, which is ordinarily the concentration interval for a proposed storm sewer. In the sense of the words as here used, rate and intensity are identical for a time interval of one hour, while the rate per hour for other time intervals is called the intensity.

The concentration interval is the time required for surface run-off to reach the outlet of a sewer from a chosen location, usually the most remote portion of the drainage area tributary to the sewer.

In order to compare rain intensities in different storms at the same place, or to compare the average or maximum intensities for a given interval at different places in a rational manner, it is desirable that the quantities compared should be equi-frequent intensities.

"Equi-frequent intensities" are those which will occur on the average in the same period of time, or which will be exceeded with an equal frequency or at equal average intervals.

The average interval in which a given rain intensity will be equaled or exceeded may be called the "exceedance interval"

for that rain intensity. It is sometimes convenient to use the term "exceedance frequency," which is equivalent to the reciprocal of the exceedance interval for a given intensity. Similarly the average interval of time in which rain intensities less than a given amount occur may be expressed by the "subceedance interval" or "subceedance frequency."

*Notation.*—"I" equals the rainfall rate, or, as it is commonly expressed, the intensity in inches per hour for any chosen time interval in minutes.

"P" equals the actual amount of precipitation at a given rate or intensity for a chosen time interval. For time expressed in minutes amount and intensity are connected by the relation

$$P \text{ equals } \frac{It}{60}$$

"T" equals the average exceedance interval in years for any chosen intensity and duration.

$N_t$ equals average annual number of thunderstorms per year.

$P_s$ equals average summer precipitation, May-October inclusive.

a, b and c are constants, and m and n are constant exponents.

*The Development of Rain Intensity Formulas*

In the earlier studies of this subject no attempt was made to deduce equi-frequent intensities directly. The usual method of deriving rain intensity curves has been to plot all high intensities included within the record as ordinates, and the corresponding time intervals as abscisses. This is illustrated by Fig. 1. Points are numerous in the lower and left-hand portions of the sheet, becoming sparse as the maximum curve is approached.

The curves are arbitrarily located so as to envelop all or most of the plotted points. The curve, Fig. 1, representing maximum intensity might be moved either upward or downward considerably, and still represent rain intensities "that occur only rarely." The position of this curve is in reality determined by relatively few points. The location of the ordinary maximum curve is purely arbitrary, and it may represent intensities which will probably occur twice as frequently in one locality as in another. Hence such a curve without some qualifying factor, dependent on local conditions, cannot be safely applied over broad areas.

If the curve was so located that the probable frequency with which the intensity represented by any portion of it would be exceeded would be about the same, we should apparently have a more rational basis for storm sewer design. Unless the maximum curve used fulfills this requirement, then it is obvious that one portion of a sewer system having its period of concentration, say, 10 minutes, may have its capacity exceeded on an average once in 10 years, while another portion having a concentration interval of 30 minutes may not be flooded oftener than once in 20 years on an average.

The purpose of the design is to make the system homogeneous, all portions being equally efficient.

In 1885 Professor F. E. Nipher, of St. Louis, published (The American Engineer, May, 1885) the results of a study of rain intensities for a period of 47 years at St. Louis. Nipher adopted the formula,

$$2\ T = 6 \text{ or } I = \frac{360}{t} \qquad (1)$$

This is the equation of an equilateral hyperbola.

In 1889 the late Emil Kuichling (Report on Proposed East Side Trunk Sewer for Rochester) developed the following formulas for rain intensities at Rochester, N. Y.:

For periods less than one hour—

$$I = 3.73 - 0.0506\ t \qquad (2)$$

For periods of one to five hours—

$$I = 0.99 - 0.002\ t \qquad (3)$$

For 20 heaviest storms of equal duration the following formula was derived as a probably more accurate substitute for No. 2:

$$I = 2.10 - 0.0205\ t \qquad (4)$$

Kuichling used straight lines to represent the envelope, but states that the envelope for Rochester "might possibly be a hyperbola, but not an equilateral."

The stimulus for this line of study largely arose from Kuichling's work, although most later investigators have adopted a more or less arbitrarily modified hyperbolic intensity curve, following A. N. Talbot.

The accompanying diagram, Fig. 1, shows Kuichling's data and resulting lines and formulas. It will be noted that Kuichling's studies indicate a discontinuity or sudden break in the rain intensity curves for a duration of about one hour. In other words, rain intensities of less than about one hour's duration, according to Kuichling's diagram, follow a different law from that governing the relation of intensity to duration for periods longer than one hour.

In 1891 Professor A. N. Talbot analyzed most of the then existing data of rain intensity for the United States by geographic districts. (The Technograph, University of Illinois, 1891, pp. 103-117.) Talbot derived two equations; the one represents an approximate envelope of all the plotted points and is assumed to give rain intensities which are rarely exceeded. This equation is:

$$I = \frac{360}{t + 30} \qquad (5)$$

Like Kuichling's lines, the derivation of this curve practically disregards all but the highest rain intensities.

Talbot's lower curve is intended to represent rain intensities which are exceeded frequently. His equation is:

$$I = \frac{105}{t + 15} \qquad (6)$$

The corresponding lines on Talbot's diagram, for different geographic sections of the country, are so drawn that most of the plotted points for time intervals exceeding 30 minutes lie above the line. The form of equation adopted by Talbot was apparently assumed arbitrarily. The same type of equation has been adopted by most subsequent investigators.

Talbot was the first to make a general study of the relation of rain intensities to geographic position and mean rainfall. His conclusions were:

(1) That there is no relation between geographic position and rain intensity for short intervals in eastern United States, and

(2) That there is no relation between mean annual rainfall and rain intensity for short intervals.

Both these conclusions are undoubtedly incorrect, a fact which is probably due to the meager and somewhat unsatisfactory character of the data available at the time Talbot's studies were made, and further owing to the fact that in these and most earlier studies of comparative rain intensities equifrequent intensities were not used.

In the past 25 years a large number of rain intensity formulas have been published in this country. Metcalf & Eddy (American Sewerage Practice, Vol. 1, p. 230) give 30 such formulas. These and many others are derived, for the most part, with relation to some single location or station.

Meyer (Elements of Hydrology) gives 35 such formulas, derived with reference to geographic location and for different exceedance intervals. A few investigators have adopted the type of equation used by Nipher, which may be written in its most general form—

$$I = \frac{K}{t^n} \qquad (7)$$

Some have adopted the form of expression

$$I = \frac{a}{b + t^1} \qquad (8)$$

with an exponent n having a value other than unity. A few have adopted more complex algebraic expressions, but the majority, following Talbot, have adopted equations of the type

$$I = \frac{a}{b+t} \qquad (9)$$

which is identical with formula (8) with exponent n equaling unity.

The type of formula used by Kuichling may be written in the general form—

$$I = \frac{a}{t^n - b} \qquad (10)$$

To this list may be added, for purposes of further discussion, the type of formula

$$I = \frac{a\,(1-e^{Kt})}{Kt} \qquad (11)$$

where e is the base of Napierian logarithms.

A comparison of formulas derived by different authorities for the same station or locality shows that there are often wide differences in the results for the same time interval. Sometimes different formulas agree for certain time intervals and are discordant for other time intervals. Formulas of the type of No. 7 give an infinite rain intensity for zero time. Formulas of the types 8 to 11, inclusive, all give a finite maximum intensity for zero time. In formulas 7, 8, 9 and 11 the intensity approaches zero as a limit as the time increases, while in formula 10 the intensity becomes zero for some definite finite time.

Formulas 7 and 9 each contain two arbitrary constants and can each be made to pass through two selected points on the intensity curve. In addition, formula (9) passes through the point a/b for t=0. Formulas of the type (8) contain three arbitrary constants and can be made to pass through three chosen points on the intensity curve, in addition to intersecting the axis of Y at the point a/b for t=0.

Assuming that a rain intensity curve has been plotted from observed data and that it is desired to find an equation for the curve, using a 2 constant formula, quite a different result may be obtained if the points selected for determining the constants, and through which the curve must pass, are those corresponding to 5 and 25 minutes, for example, as compared with the results obtained if the points selected correspond to time intervals of say 10 to 60 minutes.

In general, much closer agreement with the experimental curve may be obtained by the use of a 3 constant formula. The derivation of such a formula is, however, as a rule, relatively laborious, since one of the constants must usually be determined by trial, whereas in the 2 constant formula both of the constants can be calculated directly from two pairs of values of the variables.

All the types of formulas given, except (11) have been adopted in a purely empirical manner without regard to the question whether or not there are underlying physical conditions which make the use of one type of formula more rational than the other.

If, as may be the case, and as suggested by Kuichling, the average relation of high rain intensities to time for short durations follows a different law from that for longer durations, then the determination of this law, and of the best and most rational formula to represent the experimental data in accordance therewith, is a matter of great importance in connection with storm sewer design.

Before giving further study to the subject of the most rational type of rain intensity formula, it is proper to discuss at some length the physical and meteorological processes underlying the causation of high rain intensities.

*Causes of Excessive Rain Intensities*

The predominating cause of rain, especially in such storms as produce the high rain intensities for short intervals, which are involved in storm sewer design, is the dynamic cooling of an ascending air current. Consider a mass of warm, moist air near the earth surface; if it ascends to a higher level in the atmosphere from any cause, it will expand and cool in accordance with the well-known gas laws, owing to the reduction in barometric pressure at increased elevations. When the ascending air mass is cooled to the dew point, vapor condensation will take place and will continue as the air ascends higher. The mass of condensation increases with increased initial vapor content, and is greater in general the higher the mass of air ascends.

High initial vapor content can, in general, only exist in warm air, hence relatively high temperature is a usual condition precedent to rains of high intensities. The ascent of a mass of air may be brought about by three principal methods:

(1) The upward deflection of a moist air current blowing against a mountain slope.

(2) The ascent of moist, warm air which forms a part of the normal mechanism of circulation in a cyclonic storm.

(3) The ascent of masses of moist warm air as a result of convection.

The last is the general cause of thunderstorms, although they may also occur in conjunction with cyclonic storms, whether a thunderstorm occurs as a local phenomenon in connection with a general cyclonic rain or not. The characteristics of the rain which convection produces are generally so distinct from those of rain occurring under other conditions that the two should be considered separately in studies of rain intensity.

Nearly all high rain intensities occur in the summer. This is not altogether due to temperature, per se, for aside from thunderstorms, in which, as will be shown, most high rain intensities occur, there is a marked difference between summer and winter cyclonic storms, the causes of which are not fully explained. Rains occurring in summer cyclonic storms, excluding thunderstorms, are, on the average, of shorter duration and higher intensity than in storms occurring during the winter months.

*Relation of Thunderstorms to Excessive Rain Intensities*

Nearly all problems in urban and suburban storm sewer design involve rain intensities of less than one hour's duration, and probably the majority involve rain intensities of 5 to 30 minutes' duration.

TABLE I—SHOWING LOCATION, ELEVATION, AVERAGE NUMBER OF THUNDERSTORMS PER YEAR, AND THE PERCENTAGE OF INSTANCES OF EXCESSIVE PRECIPITATION ASSOCIATED WITH THUNDERSTORMS, FOR A FEW SELECTED STATIONS. (W. H. ALEXANDER.)

| Stations | Elevation (Feet Above Sea Level) | Average No. Per Year | Pct. Excessive Rains in Thunderstorms |
|---|---|---|---|
| Atlanta, Ga. | 1,174 | 62.6 | 95 |
| Bismarck, N. Dak. | 1,674 | 28.5 | 100 |
| Boston, Mass. | 125 | 18.0 | 66 |
| Chicago, Ill. | 595 | 40.0 | 94 |
| Cleveland, Ohio | 762 | 38.4 | 94 |
| Denver, Colo. | 5,272 | 46.7 | 100 |
| Galveston, Texas | 69 | 48.1 | 81 |
| Jacksonville, Fla. | 43 | 79.5 | 73 |
| New Orleans, La. | 51 | 74.4 | 87 |
| New York, N. Y. | 314 | 28.4 | 66 |
| Portland, Ore. | 57 | 5.4 | (1) |
| St. Louis, Mo. | 567 | 52.6 | 91 |
| San Francisco, Cal. | 155 | 0.8 | (1) |
| Santa Fe, N. Mex. | 7,013 | 73.2 | 100 |
| Tampa, Fla. | 67 | 94.4 | 84 |
| Washington, D. C. | 112 | 39.2 | 87 |

(1) Excessive precipitation practically unknown at this station; but few thunderstorms and those of a mild form.

The data in Table I furnish a basis for the comparison of rain intensities with mean precipitation and thunderstorm frequency and are here used for that purpose only. Those desiring to consult the original data or the 35 formulas derived therefrom by Meyer will find them in excellent form in Meyer's book, Elements of Hydrology.

Let $N_t$ equal mean number of thunderstorms per year.

$T_e$ equal Exceedance interval in years.

t equal time in minutes.

a and b are constants; $a_1$ and $b_1$ are the values of a and b for one year exceedance frequency.

m and n are exponents.

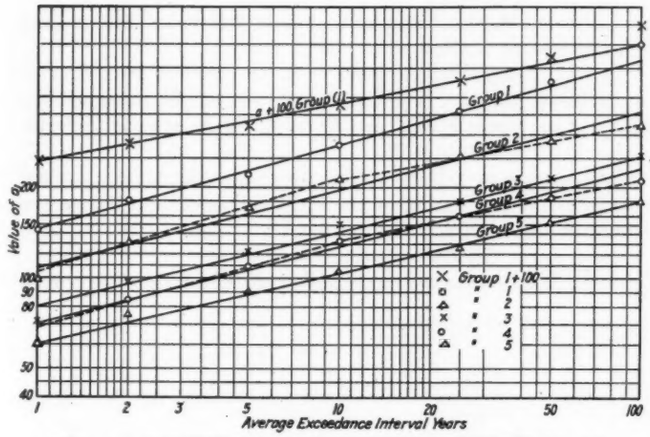



FIG. 2. VALUES OF a IN MEYER'S FORMULAS IN TERMS OF EXCEEDANCE FREQUENCY AND $a_1$

Then using the ordinary base formula:

$$i = \frac{a}{b + t}$$

An effort has been made to express the constants a and b in terms of thunderstorm frequency and to evaluate a frequency relation in terms of $T_e$ which may be incorporated in the same general formula.

Plotting Meyer's values of a for a given group in terms of exceedance frequency, Fig. 2 has been obtained. While there are some variations, the values of a can be expressed for all the groups by straight logarithmic lines of nearly equal slope, having the equation

$$a = a_1 T^m$$

where $a_1$ is the value of a for one year exceedance frequency. The slope of the lines is not constant, but increases slowly as $a_1$ increases, indicating that m is a function of whatever causes affect $a_1$, including probably thunderstorm frequency. This will be evaluated later on.

A similar diagram was prepared (Fig. 3) showing the relation of Meyer's values of b to the exceedance interval for the different groups. Here again logarithmic straight lines having slopes varying with $b_1$ fairly represent the data, so that the equation for b may be written—

$$b = b_1 T^n$$

where n is yet to be evaluated.

The values of $a_1$, $b_1$ and of the exponents m and n, indicated by Figs. 2 and 3, were then tabulated in conjunction with the mean annual number of thunderstorms at stations included in each group as follows:

| Group | $N_t$ | $a_1$ | m | $b_1$ | n |
|---|---|---|---|---|---|
| 1 | 67.3 | 145 | 0.28 | 22.6 | 0.20 |
| 2 | 48.9 | 108 | 0.27 | 19.0 | 0.12 |
| 3 | 41.6 | 78 | 0.26 | 15.0 | 0.11 |
| 4 | 30.8 | 71 | 0.25 | 15.5 | 0.08 |
| 5 | 28.5 | 61 | 0.236 | 12.0 | 0.04 |

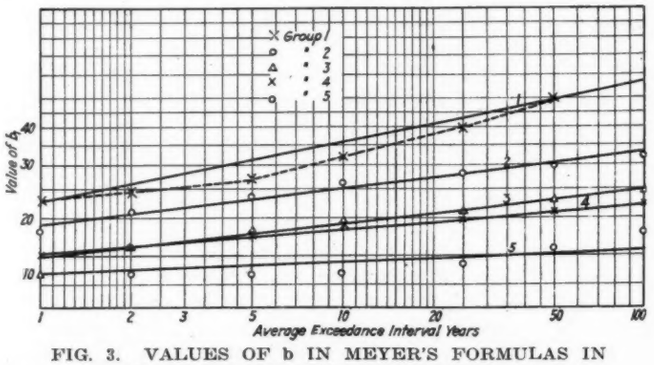



FIG. 3. VALUES OF b IN MEYER'S FORMULAS IN TERMS OF EXCEEDANCE FREQUENCY AND $b_1$

The mean annual number of thunderstorms, $N_t$, was deduced from tables by William H. Alexander in the Monthly Weather Review, July, 1915, and are means for the ten-year period, 1904-1913.

Plotting these data in terms of $N_t$ as independent variable, Fig. 3 is obtained. The relations of the coefficients $a_1$, $b_1$ and exponents m and n to thunderstorm frequency are all quite consistent, and may be represented by the straight line relations given on Fig. 4. The general rain intensity formula may now be written

$$i = \frac{a_1 T^m}{b_1 T^n + t}$$

The values of $a_1$, $b_1$, m and n, and their relations for various values of $N_t$ are given in Table II.

TABLE II—CONSTANTS, MEYER-HORTON FORMULA

| $N_t$ | $a_1$ | $b_1$ | $a_1/b_1$ | $a_1/b_1/Nt$ | m | n |
|---|---|---|---|---|---|---|
| 0 | 0 | 7.5 | 0 | .0 | .220 | —.057 |
| 10.0 | 22 | 9.8 | 2.24 | .229 | .229 | —.019 |
| 20.0 | 43 | 12.0 | 3.58 | .179 | .238 | .019 |
| 30.0 | 65 | 14.3 | 4.55 | .152 | .247 | .057 |
| 40.0 | 86 | 16.5 | 5.21 | .130 | .256 | .095 |
| 50.0 | 107.5 | 18.8 | 5.72 | .114 | .265 | .133 |
| 60.0 | 129.0 | 21.1 | 6.12 | .102 | .274 | .171 |
| 70.0 | 150.5 | 23.3 | 6.96 | .092 | .283 | .209 |
| 80.0 | 172.0 | 25.6 | 6.72 | .084 | .292 | .297 |
| 90.0 | 193.5 | 27.8 | 6.96 | .077 | .301 | .285 |
| 100.0 | 215.0 | 30.1 | 7.16 | .072 | .310 | .323 |

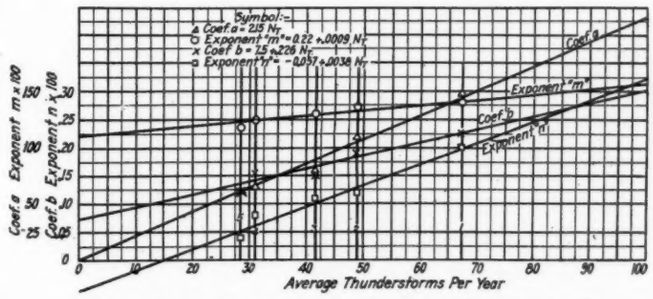



FIG. 4. RELATION OF THUNDERSTORM FREQUENCY TO COEFFICIENTS IN GENERALIZED FORMULA FOR RAIN INTENSITY. BASED ON MEYER'S FORMULAS.

This formula not only replaces the 35 special formulas on which it is based, but may be used for other or intermediate exceedance intervals, and for other stations than those included in Meyer's groups, provided the thunderstorm frequency is known. From the accompanying map, Fig. 5, the mean thunderstorm frequency for most localities in the United States can be determined.

To compare the results given by the general formula with the original data and formulas, take the case of group 4, with ten-year exceedance frequencies:

Here $N_t = 30.8$. Then $a_1 = 66.2$.

$m = .248$ $\quad b_1 = 14.46$ $\quad n = 0.06$

$$i_{10} = \frac{66.2 \times 10^{0.248}}{14.46 \times 10^{0.06} + t} = \frac{117.2}{16.63 + t}$$

Meyer's formula for this group is:

$$i = \frac{132}{19 + t}$$

The results by the two formulas compare as follows:

| t = | 5 | 10 | 15 | 30 | 45 | 60 | 80 | 100 | 120 |
|---|---|---|---|---|---|---|---|---|---|
| Meyer's | 5.52 | 4.56 | 3.88 | 2.70 | 2.06 | 1.67 | 1.33 | 1.11 | 0.95 |
| Meyer-Horton | 5.43 | 4.40 | 3.39 | 2.53 | 1.90 | 1.55 | 1.21 | 1.01 | 0.86 |
| Original data | 5.40 | 4.56 | 3.60 | 2.48 | | 1.57 | 1.08 | 0.96 | |

The agreement of the general formula with the original data in this case happens, on the whole, to be rather better than for the single special formula.

It will be noted that the constants in the general formula can all be expressed as functions of $a_1$—this facilitates the use

of the formula for the extension of a short record, since $a_1$ can be fairly determined from a much shorter record than is required to determine the more infrequent intensities.

It is not to be understood that use should be made of thunderstorm frequency data alone as a basis of rain intensity studies, where better data are available. The determination of the coefficients in a rain intensity formula from even a relatively short record with the recording rain gages are preferable. If this is not available, thunderstorm data may be used, but it is better to use an average of the data for several stations subject to similar conditions, in order to eliminate the effect of personal equation in any single thunderstorm record. It is customary to record as thunderstorm days all days on which thunder is distinctly heard, whether rain occurs or not; furthermore, there may be two or more distinct thunderstorms on a single day. It would probably furnish better data for correlation with rain intensity if thunderstorm records were kept in such a manner as to show the total number of occurrences of thunder in conjunction with rainfall at the recording station, counting each distinct thunder shower separately.

It seems probable that the relation between thunderstorm frequency and rain intensity is closer and more definite than the existing thunderstorm statistics reveal.

*(To be Concluded in the July Number.)*

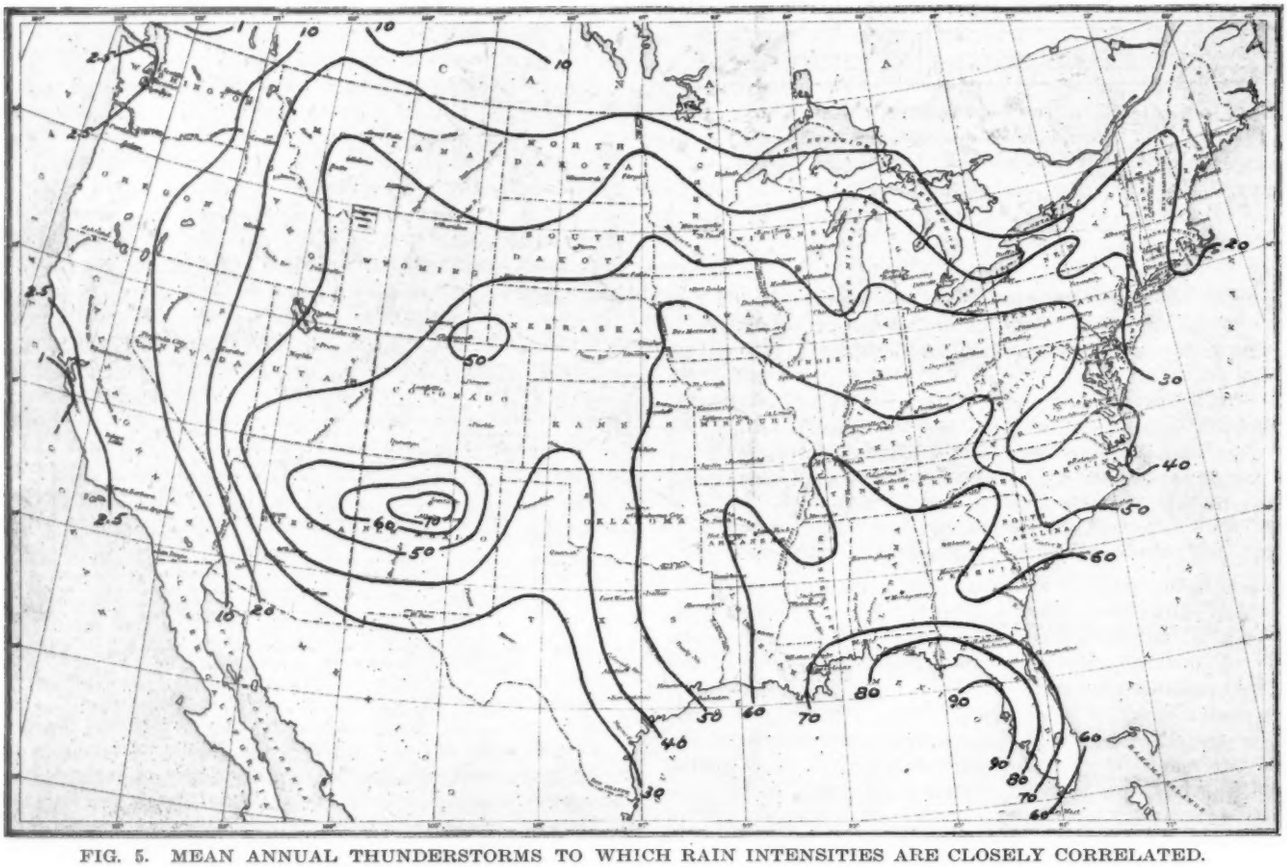


FIG. 5. MEAN ANNUAL THUNDERSTORMS TO WHICH RAIN INTENSITIES ARE CLOSELY CORRELATED.

## Concrete in Roads, Bridges and Culverts

*By H. Eltinge Breed, Consulting Engineer, 507 Fifth Ave., New York City*

Concrete pavement is composed of cement and fine and coarse aggregate, with the admixture of water. Fine aggregate is sand, crushed slag or rock, consisting of hard durable particles smaller than ¼ in. in size, free from organic impurities, carrying not over 5 per cent. of silt or loam, and of such gradation as will give equal or greater compressive strength than the standard Ottawa sand, when tested in like manner using the same cement.

Coarse aggregate is crushed rock or pebbles, consisting of tough, hard particles free from dust and of such size as will pass a 3 in. circular ring and be retained in a ⅜ in. circular ring.

The success or failure of the pavement depends on quality, sizing and proportioning of the materials and the placing and curing of the concrete.

*Testing of the Fine Aggregate*

First in importance are the materials used; they determine the quality of the pavement. The fine aggregate should be tested for:

1. Organic Impurities.
2. Gradation (sieve analysis).
3. Mortar strength.
4. Volume of silt or loam.

I shall give only the field tests, as these are the most useful and can be readily made by the inspector to determine that the material being used measures up to that approved by the laboratory tests.

*Organic Impurities*

1. Organic impurities are detected as follows:

"Fill a 12 oz. graduated prescription bottle to the 4½ oz. mark with the sand to be tested. Add a 3 per cent. solution of sodium hydroxide until the volume of the sand and solution, after shaking, amounts to 7 oz. Shake thoroughly and let stand over night. Observe the color of the clear supernatant liquid." If it is colorless, or has a bright yellow color, any organic impurities contained are harmless. If it shows a darker colored solution, the sand should be rejected and accepted only after full laboratory test, a description of which can be found in Part I of the 1917 Proceedings of the American Society for Testing Materials, pages 327-333.

*Gradation*

2. Gradation tests for sand (sieve analysis). Field Test-

TABLE I—RESULTS OF IMPACT TESTS ON 6 IN. CONCRETE CUBES

| Coarse Aggregate | Fine Aggregate | Mix | No. Tests | Grams loss per Test | Average Loss | Remarks |
|---|---|---|---|---|---|---|
| Trap | Sand, Niagara | 1-1½ | 3 | *150-110 | | *Small |
| | | | | 105- 95 | 103 | stone area |
| Trap | Sand, Cowbay | 1-1½-3 | 4 | 110-120 | 110 | omitted |
| | | | | 110-100 | | |
| Trap | Sand, Albany | 1-1½-3 | 4 | 140-100 | 122 | |
| | | | | 125-125 | | |
| Trap | Sand, Long Island | 1-1½-3 | 2 | 120-135 | 127 | Group (1) |
| Trap | Sand, Marlboro | 1-1½-3 | 2 | 130-135 | 132 | 103-165 |
| Trap | Tailings, Graphite | 1-1½-3 | 2 | 155-135 | 145 | |
| Trap | Sand, Booneville | 1-1½-3 | 4 | 165-130 | 149 | |
| | | | | 165-135 | | |
| Trap | Tailings Iron Ore | 1-1½-3 | 5 | *200-155 | | *Excess |
| | | | | 165-155 | 164 | grout |
| | | | | 165-180 | | omitted |
| Trap | Sand, Cowbay | 1-2-4 | 2 | 150-150 | 150 | |
| Trap | Sand, Albany | 1-2-4 | 3 | 180-160 | | Group (2) |
| | | | | 185-225* | 175 | 150-175 |
| Trap | Sand, Marlboro | 1-2-4 | 2 | 180-170 | 175 | *Small |
| Syenite | Sand, Booneville | 1-1½-3 | 8 | 150-145 | | stone area |
| | | | | 150-140 | 141 | Excess |
| | | | | 145-125 | | grout |
| | | | | *185-130 | | omitted |
| Syenite | Sand, Booneville | 1-2-4 | 4 | 180-205 | 186 | Group (3) |
| | | | | 180-180 | | 141-186 |
| Buffalo Limestone | Sand, Niagara | 1-1½-3 | 5 | 150-120 | | *Small |
| | | | | 155-125 | | stone area |
| | | | | 135 | 137 | omitted |
| Limestone | Sand, Cattaraugus | 1-1½-3 | 5 | 155-160 | | Group (4) |
| Limestone | | | | 140-125 | 148 | 137-170 |
| | | | | 160-200* | | *Excess |
| Buffalo Limestone | Sand, Boonville | 1-1½-3 | 4 | 180-160 | 171 | grout |
| | | | | 185-160 | | omitted |

ers are made which have the ¼ in., the 20 and the 50 sieves. By the use of these it can be determined whether the material comes within the limits of the specification.

*Mortar Strength*

3. Mortar strength test must be made in the laboratory, on account of the necessity of a testing machine to determine the compressive strength. However, a test for set can be made in the field by mixing the sand with cement and forming a pat with thin edges. By breaking the edges after 24 to 48 hours, the engineer can determine how the material sets.

*Silt or Loam*

4. Volume of silt or loam is determined by adding an excess of water to a given quantity of sand in a glass graduate. The whole is well agitated and allowed to stand until the loam and silt has settled on top, when their percentage may be measured.

*The Coarse Aggregate*

The coarse aggregate cannot be tested in the field. Field determination of these materials can be made only for voids. Visual inspection should, of course, detect soft material and dirty aggregates. Such inspection should be made constantly, to know that the material is running uniform and of quality equal to the original sample. When we realize that nature never has two deposits alike, the importance of these tests in securing good work will be readily appreciated.

For laboratory test of coarse aggregates, the most valuable is the Deval abrasion test. It is in general use and has been standardized. How accurate it is in determining the suitability of coarse aggregate for concrete remains to be seen. Certain it is, however, that this test indicates the difference between poor and good stone; and taken in conjunction with the impact test, which I will describe later, it is the best means we yet have of determining the suitability of stone for concrete roads.

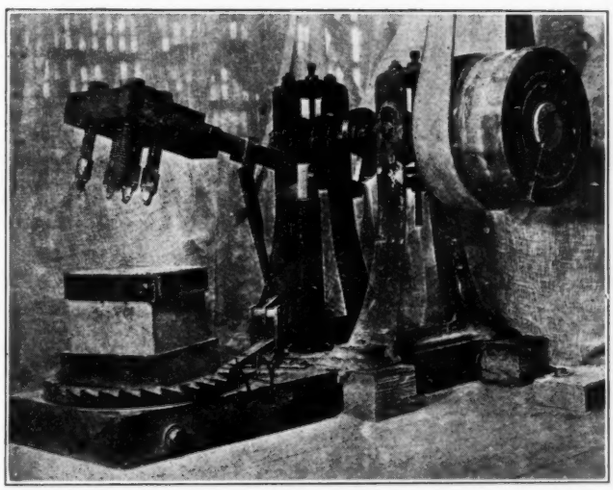
The tests for pebbles, by some called gravel, with the Deval machine have been unsatisfactory, because certain pebbles much inferior in service to trap and syenite rock, show less loss when tested than do these standard materials. In 1915, in our New York State Highway Department Laboratory, we modified the Deval stone abrasion machine, by substituting a slotted cylinder for the closed cylinder. The slots allow the fines to escape, so that there is no protective cushion of dust to keep the pebbles from wear. For four years we have found that this machine has given slag and pebbles a truer rating in accordance with the service test, though often at variance with the showing of the standard cylinder.

After testing the aggregates, we make tests of the concrete they compose for two purposes: first, to determine its wear; second, to determine its strength.

*Testing Wearing Qualities of Concrete—Impact Tests*

By far the most valuable test to determine the wear resisting values of various aggregates used in concrete roads, is a machine which generates impact stresses, closely paralleling those set up by traffic. In general the machine consists of an arm which is raised by a cam and falls freely, striking the concrete cube. At the head of the arm are placed nine hitting points, armored with non-slip horse calks, each point and its shaft being held in place by a spring giving ½ in. play to compensate for any irregularity or unequal wear during test in the surface of the sample. The effective weight of the head is 29 lbs., and the blows are delivered at the rate of 100 per minute. The sample used is a 6 in. cube or cylinder placed upon a table which is revolved by a dog attachment, so that the blows of the calks strike in 9 concentric circles ¼ in. apart. To date, several hundred tests have been run with this machine, of which the results given in Table I are representative.

The results in Table I indicate that generally the average loss increases as the mortar strength of the sand decreases. An average loss for each test shows that there is greater



IMPACT MACHINE USED IN MAKING IMPACT TESTS BY THE NEW YORK STATE HIGHWAY DEPARTMENT.

strength in the 1-1 1½-3 mix than in the 1-2-4 mix. It is interesting to note that syenite with the French coefficient of 12.5 shows approximately an equal loss under this test to Buffalo limestone with a French coefficient of 7.9. On the basis of the Deval Test, the limestone is inferior for road purposes to the syenite, but service conditions indicate that the Buffalo limestone and many other limestones with a French coefficient of 7 and better are very satisfactory in service. Full results of these impact tests I have for anyone with sufficient leisure and energy to peruse them. In general six conclusions from them seem justifiable:

*Conclusions from Impact Tests*

1. Crushed stone concrete resists impact better than gravel concrete.

2. Large sized material is more durable than the small sizes.

3. Toughness is a very important factor in aggregate that is subjected to impact.

4. The fine and coarse aggregate must both be good if we are to get the most from the pavement.

5. Coarse grained sand mortar resists impact better than a mortar made with finer grained sand.

6. No relation has as yet been observed between compressive strength and resistance to impact.

In the test to indicate strength concrete from a batch is made up on the road into 6 in. cubes or 6 by 12 in. cylinders from every 500 cu. yds. or less of material. They are cured for 21 days in moist sand and then shipped into the laboratory and tested at 28 days. The following is a record of four years' work done under my direction:

| Years. | Mix. | Coarse Aggregate | No. of Cubes. | Average Compression per Sq. Inch. |
|---|---|---|---|---|
| 1915-16..... | 1:1½:3 | Stone | 1684 | 3590 |
| 1917-18..... | 1:1½:3 | Gravel | 221 | 2950 |

It will be noted that a total of 1,905 tests were made and that with the exception of the gravel they are well over 3,000 lbs. per square inch. When any individual test shows below 3,000 lbs. we immediately made a thorough investigation to determine the cause. While this would occur too late to correct the given piece of work, it had a good moral effect on the contractor, and wholesome rivalry was inspired among the engineers to have a high test value for their work. The figures given above represent actual tests from the laying of something over 400 miles of 16-ft. concrete pavements of 6 ins. average thickness.

Next in time, but of equal importance to the choice of materials, is the method of application. Upon this depends the strength of the pavement.

*Proportioning Materials*

The mix should be proportioned in such a manner as to give the greatest density. For the general run of materials and the strength necessary, the 1:1½:3 mix most nearly meets all requirements. By varying slightly the fine and coarse aggregates as indicated by the field tests for voids, the greatest density is obtained. The coarse aggregate should consist of well-graded particles from ⅜ to 3 ins. in size.

*Mixing Materials*

Mixing should be thorough and of at least one minute duration; however, many specifications require a minute and a half. Whatever the requirement, there is just one sure way to get the full time called for; that is by use of the batch meter. It eliminates all argument with the inspector. It is fairer to the contractor, for it puts them all on the same basis. The water used must be clean and free from oil, acid, alkali, or organic matter. An excess of water impairs the strength of the concrete. Only enough should be used to make the concrete workable. Professor Abrams says that his experiments show that one pint more water than necessary to produce a plastic concrete reduces the strength to the same extent in a one-bag batch as though it had been robbed of 2 or 3 lbs. of cement. Bulletin No. 1, entitled "Design of Concrete Mixtures," by Duff A. Abrams, Lewis Institute, Chicago.

*Placing and Finishing Concrete*

There are two methods of finishing concrete after it has been placed upon the sub-grade. One is by the use of a machine finisher; the other, which is still more generally used, by hand. The machine type of finishing is proving more and more satisfactory. It gives a uniform, smooth finished result, lessens the amount of labor behind the mixer—a decided advantage in the present labor shortage—and by permitting a stiffer mix insures a stronger concrete. By hand, the finishing is done in various ways. The one that gives the best results is by use of a steel shod strikeboard to level and tamp the concrete. This should be followed by a light roller to take off the excess water and compact the concrete. In some cases this is all the finishing that is done. Greater smoothness may be secured, however, through the use of two belts, which are drawn backward and forward across the pavement with a slightly diagonal motion in moving ahead.

*Curing the Concrete*

On this depends the final set and durability of the pavement; soon after the use of the final belt the surface should be protected by an awning of canvas to prevent rapid evaporation. There are two methods of curing, that of the earth covering, with subsequent sprinklings to keep the earth moist, and that of ponding. Both of these methods can be put in operation as soon as the concrete has hardened sufficiently to stand the earth cover or the dams for the pond. With the earth cover at least 2 ins. of earth should be put upon the pavement; for the ponding, a depth of 2 ins. of water should be carried. If the temperature is running below 50 deg. Fahrenheit, the covering can be omitted and the concrete sprinkled two or three times a day. Traffic should be kept off the pavement for at least 14 days, though the cover can be removed after 10 days of ordinary weather. During cold weather, opening to traffic should be still further deferred unless calcium chloride is used to accelerate the set of the concrete.

*Bridges and Culverts*

All that I have said so far of concrete for roads applies equally to concrete for bridges and culverts, with the exception of such obvious details of curing and finishing as must be familiar to every one. Worthy of special emphasis here, however, is the concrete pipe culvert, because many road builders do not yet seem fully aware of its value. The laying of culverts is almost the first piece of work to be done on a job. To have to wait for the arrival of sand and stone to mix concrete often means loss of time and labor that would be conserved if the contractor had his concrete pipe culvert delivered direct from the manufacturer all ready to put in. Then the rest of the work could proceed independently and to greater advantage. The head walls of the culvert can, of course, be built on at any time.

All that has preceded might stand as part of a primer on concrete road building. It is trite. I have ventured to bore you with the repetition of it only because every failure I have ever seen in concrete pavement work has been directly traceable to some neglect of these first principles.

Now, taking for granted the skill and care essential to the success of our pavement, let us jump from the Primer to the Last Chapter of a treatise on engineering. Consider very briefly Economy of Construction.

*Economy of Construction.*

There are three general methods of building concrete roads.

1. The delivery of the materials on the sub-grade.
2. The delivery of batches direct to the mixer.
3. The manufacture of materials at a central mixing plant.

The first method (materials on the sub-grade) has the advantage as a rule of lower plant charges, but it requires more labor and involves a loss of from five to ten per cent. of the materials used, plus the necessity of re-shaping the sub-grade. The second method (delivery of batches direct to the mixer) has the advantage of saving the loss of materials on the sub-grade and eliminating the extra grading cost; it lessens the number of laborers needed and insures the delivery of materials, when industrial track is used, at times of soft sub-grade and inclement weather. The third method (the central mixing plant) is most economical of all. It saves time and labor through the stationary mixer and the once-made sub-grade. Its chief disadvantage, the segregation of materials in transit, may be obviated by the use of a dry mix and a finishing machine.

If the materials are placed upon the sub-grade, great care should be taken that the piles or winrows of material are of such size and so placed as to require little handling to get them to the mixer. I have known poor placing to increase the manipulation cost one-third.

Where local stone is being manufactured, screenings can be used in some cases for the fine aggregate. Thus we save what generally is a waste product. However, before permitting their use, thorough tests should be made of their fixtures. I have had tests made of commercial stone screenings showing

all the way from 95 to 240% of the compression strength of Ottawa Sand.

A thorough examination of the site of the work and its surrounding territory will often disclose good available local materials. One may fall here between two evils—a too cursory or inexperienced examiner who finds nothing where there is much; or a too zealous discoverer who ardently insists that what he finds is good, whether or no. The people for this work are those with sound training in geology and mineralogy. They will save the state many thousands of dollars that might be lost either through the consideration of poor materials through needless transportation charges.

In another way hitherto neglected, can the State save large sums in building its concrete roads. We all know that by the use of well-graded aggregates in making concrete the necessary amount of cement, its most costly factor, is diminished. In other words, the finer stones fill up the interstices that would otherwise absorb cement and sand. Or, using the same amount of cement and sand, and the well graded stone, you can get an increase over the ungraded stone of from five to ten per cent. in bulk. Shrewd contractors have been quick to take advantage of this, in spite of the fact that some states, like New York, have written their specifications for a graded aggregate. I believe the states would save large sums of money and secure *much* better work by buying *all* the materials for the concrete used in road work.

I will say, with a careful attention to adjectives, that built with due care for first principles and close observance of practical economies, the concrete road will yield generally satisfactory results at comparatively low cost.

*Acknowledgment*

The foregoing is from a paper presented at the recent Sixth Canadian Good Roads Congress.

## Location of Subsurface Pipe Lines to Conserve Street Pavements

*By Harry M. Adams, Assistant Engineer, 3219 Parkside Place, Borough of the Bronx, New York City.*

Each year as the underground congestion grows worse from the accumulation of pipes that past decades have dumped into our streets, the problem of the maintenance of our pavements becomes even more difficult.

In the downtown business section of New York City we have a network of pipes of various sizes and purposes, many laid without plan or record, so today no one can say just what lies beneath the surface. This labyrinth contains many useless and abandoned mains and services, which complicates the making of ordinary repairs and causes endless confusion.

On account of this apparent official negligence, we find our streets in a state of perpetual upheaval resulting in ever-mounting maintenance cost, increasing inconvenience and menace to our health.

### *Begin Right, Now, in Unpaved Areas*

We can hardly hope to bring order out of chaos at this late day, but when we consider that in the greater city most of our streets are as yet unpaved, and vast areas are even undeveloped, there may still be time to render a valuable service to future generations by profiting by the errors of the past.

The life of a pavement, other things being equal, is in inverse proportion to the number of openings made in it. It would seem then that our policy must be so to plan future streets, that the number of structures laid beneath their pavements be reduced to a minimum, and that those installed be placed with the basic idea of avoiding duplication and conserving space.

### *Sewers and House Connections*

Let us consider what structures are required in the average street. First the sewer. It is advisable to run the sewer in the middle of the street, making house connections wherever necessary. This of course involves the opening of the street, but when once made, the connections seldom require further attention. This practice can hardly be changed unless the sewer in question is part of a lateral system in a wide street. In this case there is good reason to lay two sewers, one on each side near the curb. Connections to spurs can then be made without disturbing the pavement. Some cities require that all house connections be laid to the curb at the time the sewer is constructed.

### *Water Mains and Services*

Next, water mains. These are generally cast-iron pipes with lead joints and are laid somewhere in the roadway. They commonly fail through the lead working loose in the joints because of the vibrating loads passing over them. A vast amount of water is wasted and pavement destroyed through leakage. A leak may exist without any apparent surface indications, and the escaping water following along the pipe down the grade of the street, undermines the pavements until an arch is formed, which sooner or later, under the weight of a heavy load, crashes down, often destroying large areas of pavement.

Service connections to houses are generally lead pipe, which, being of pliable materials, are easily injured and in cold weather frequently freeze.

### *Gas Mains*

Gas mains laid in a similar manner lose volumes of gas through leakage. This poisonous substance enters sewers, subways and other structures, often causing disastrous explosions. When the odor of gas is detected, test holes are dug. Numerous openings may be made and much pavement mutilated before the leak is finally located, as the escaping gas, traveling underneath the impervious surface, seeps through where there is least resistance.

### *Electrolysis*

Service pipes, commonly of wrought iron, corrode easily, and in winter give much trouble when they become "trapped." Being of small bore and laid in shallow trenches, they often pick up stray electric currents in their course across a street. These, being carried to the main, cause electrolysis, which is "hasty consumption" of iron.

Electrical wires and cables are placed in tile or concrete ducts, and splicings and repairs are made in manholes. The distributing lines for local service are of wrought iron or fiber pipe. Subsidiary connections to houses are made from these through handholes or service boxes built somewhere in the street. These house connections frequently run diagonally across under the pavement, and, not being at right angles to the street, are not easily relocated in case of trouble.

Besides these, there are pneumatic tubes, steam pipes, refrigerating mains and others, in some of our streets, but as these are not common in the newer sections, they will not be considered except in a general way.

### *Placing Gas Mains Under Sidewalks*

The majority of street openings, however, are made to install or repair water and gas mains and services, the latter accounting for two-thirds of all openings. Let us consider the advantages to be gained by placing these under the sidewalk.

The mains could be laid without tearing up expensive pavement. The objection might here be raised that sidewalk pavement would be destroyed. This is true, but not all sidewalks are paved to their full width, and the cost of restoring sidewalk pavement, which is of light material, would be much less than that in the driveway.

They would last longer, being removed from the heavy vibrating loads of the driveway. Street traffic would be unimpeded. Water and gas waste would be quickly reduced and leaks soon discovered. Joints could be recalked without disturbing pavement.

*Service connections would be entirely eliminated from the roadway.* This is indeed important when we remember that most street openings are made on their account. Being short, they would be properly graded, preventing trapping and freezing. Leaks would be correspondingly reduced and readily found. Much material and labor would be saved. Danger from electrolysis would be minimized.

*Duplicate System of Mains*

This plan calls for a duplicate system of mains, one on either side of the street, and it may be argued that it involves waste and extravagance. The reverse of this, however, is true. On streets of a width of 80 ft. or more the dual system is already in use. Smaller mains may be used; they would last longer and need less repairing. No street pavement would be disturbed in laying connections or repairing them. *There is an actual saving of labor and material,* as the total length of main and services in a built-up street is greater than would be the total for two mains and services placed under the sidewalks.

Electrical distributing lines should be laid in shallow trenches just outside the curb, with service boxes built on them in front of premises to be supplied with service. Connections from these boxes to the house may be made without disturbing the pavement. The space underneath the roadway should be reserved for the large feed mains, trunk duct lines and sewer.

*One Office Should Control All Subsurface Structures*

The success of any plan to preserve our pavements depends primarily upon efficient administration and full co-operation of the various bureaus concerned. One office should be responsible for the proper installation of all subsurface structures from the issuing of the permit or franchise to the repaving of the street.

Every application for a franchise or permit to install a structure should be carefully scrutinized. Specific locations should be assigned with a view to avoiding duplication, conserving space and saving pavement.

All mains for local service should be placed under the sidewalk. Field notes should be kept and an accurate record filed of all subsurface structures as actually installed.

## Blasting a Ditch Through a Swamp

A ditch was recently blasted through a heavily timbered swamp on the farm of F. M. Gaines, near Dothan, Ala. The ditch is 750 ft. long and averages 7 ft. wide and from 3 to 5 ft. deep according to grade. It was cut through a bay and gum swamp covered with water and a great many logs littered the surface and were submerged throughout its course. There were also many cypress, pine, bay and gum stumps, also many small saplings in the line. None of the logs, stumps, or small growth were removed by hand.

The ditch was blasted with 40 per cent. ammonia dynamite. Holes were punched in the earth 30 ins. apart and 2½ to 4½ ft. deep depending upon the desired grade. The shallow holes were loaded with a half to three-quarters of a pound of dynamite and the deeper holes with from a pound to a pound and a half of the explosive. No tamping was necessary as water filled the holes. An electric blasting cap was inserted in each charge and the charges connected together in series by means of the cap wires. As a No. 3 blasting machine was used to fire the charges, it was necessary to do the work in 30 hole sections because that is the capacity of the blasting machine used.

Where stumps, logs and trees were encountered in the line of the ditch, oblique holes were punched so as to get the charges under the stumps or logs and heavier charges were used than where it was merely necessary to blast earth. With that exception, the work was done the same way where these obstructions were encountered as in places where only the earth had to be blasted.

The total cost of the ditch including labor was $105 or 30 cts. per lineal yard. Mr. Gaines had been trying for some time to secure laborers to dig the ditch but failed for reasons well known to all who have been endeavoring recently to employ men for hard disagreeable tasks.

## May Sets New Record in Road Work

During May the Secretary of Agriculture approved project statements for 124 Federal aid projects, involving the improvement of 750.87 miles of road at a total estimated cost of $15,120,771 and on which Federal aid in the amount of $6,382,-081.28 was requested. This represents the largest number of project statements approved during any month since the passage of the Federal Aid Road Act.

During the month there were executed by the Secretary and the several state highway departments 81 project agreements, involving the improvement of 667.71 miles of road at a total estimated cost of $7,992,867.25 and on which $3,570,087.22 Federal aid was requested and set aside in the treasury. In addition, agreements to cover 59 other projects were placed in process of execution during the month.

Up to and including May 31, 1919, project statements for 1,188 projects had been approved. The 1,188 projects involve 11,350.10 miles of road, a total estimated cost of $108,295,329.15 and a total of $43,076,176.63 Federal aid. On the same date 617 project agreements had been executed, involving 5,291.86 miles of road, at a total estimated cost of $47,426,749.49, of which $19,521,259.27 was from Federal funds.

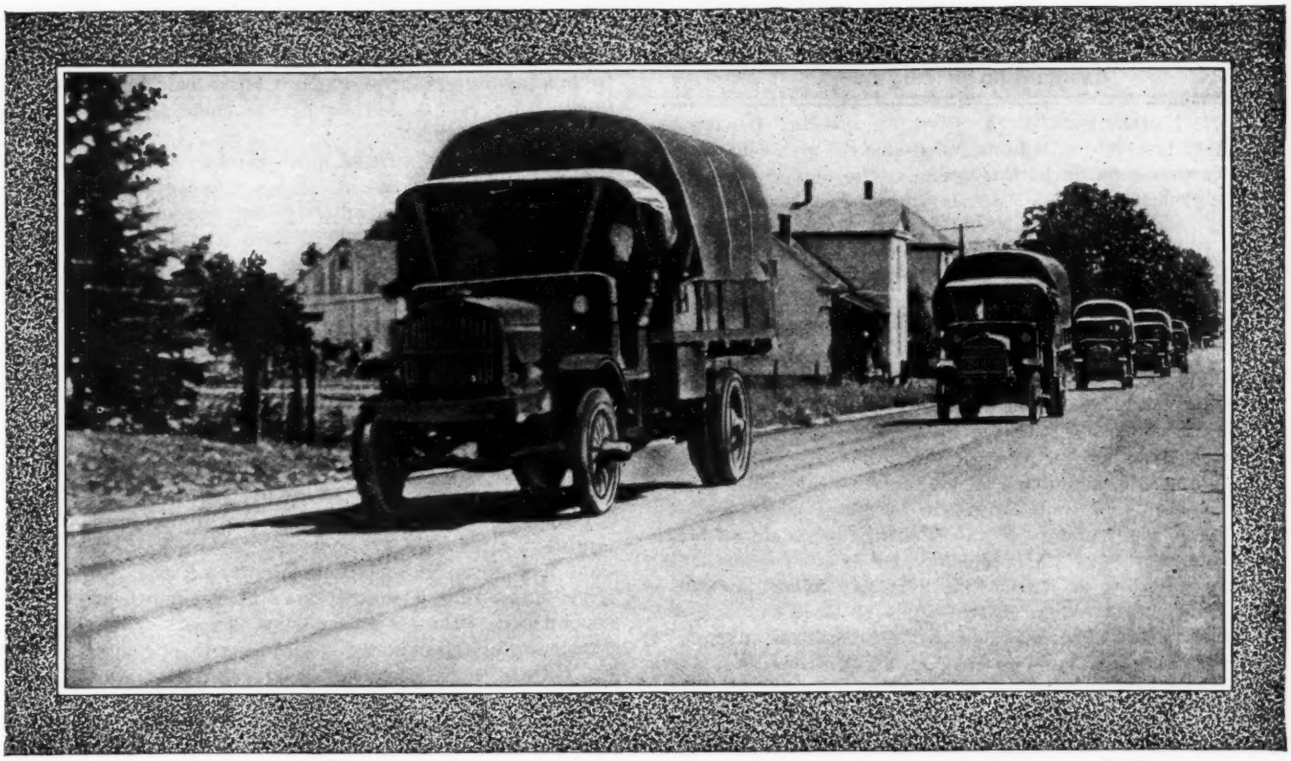
## Using Explosives in Removing Old Walls

If it is a vertical wall or abutment, probably the best way to crumble it is to drill a vertical line of holes from top to bottom, spacing the holes 3 ft. apart and 3 ft. from the edge of the free side of the wall. The depth of these holes should be equal to three-quarters the thickness of the wall and a safe, yet efficient charge would be from one-third to one-half cartridge of 40 per cent. ammonia 1¼x8 in. dynamite loaded in each hole. Each hole should contain an electric blasting cap and the wires of these should be connected in series and fired by means of a blasting machine. In this manner the wall can be broken in sections.

Another method applicable when the wall is in the open and not adjacent to damageable property, is to drill a row of holes along the bottom of the wall about 2 ft. from the ground and in depth equal to three-quarters the thickness. Holes should be drilled with a slight dip. A charge of one-half to three-quarters of a cartridge of 40 per cent. ammonia dynamite 1¼x8 in. should be loaded per hole and as many holes as desired fired at one time, unless in close quarters, when it would be best to fire two or three holes at a time. One row of holes so situated would be sufficient for a wall up to 12 ft. high and from 3 to 6 ft. thick. If higher than this, it might be best to shoot the wall in two sections, or use vertical rows of holes or load heavier charges per hole.

Brick walls crumble more easily than concrete, and do not require as heavy charges per hole, and holes can be spaced farther apart.

An old brick wall built many years ago, about 10 feet high, 4 ft. thick and 20 ft. long, was entirely demolished by placing a row of horizontal holes 2 ft. from the ground, 3 ft. apart and 3 ft. deep. In each hole was loaded one-half cartridge of ammonia 30 per cent., 1¼x8 in., and six holes fired at one time by means of a blasting machine.



*Vanguard of fleet of 38 Liberty Trucks passing through Oakville, Delaware County, Ind., in August, 1918, over Tarvia Road built in 1916. Note perfect condition of road after two years of hard service.*

# Every Community should have roads like these—

HERE is the story of how Delaware County, Indiana, got good roads, as told by the County Surveyor. Every one interested in good roads should read it.

"Our first Tarvia road was built in 1914. Between 1914 and 1918 we constructed sixteen streets and roads, with a total area of about 2,880,000 square feet.

"Some of these are main streets in the city of Muncie, others are main roads subject to heavy traffic, while others replaced low-lying gravel roads that used to wash-out at every overflow of the river.

*"Every Tarvia road and street in Delaware County has given uniform satisfaction. No repairs have been necessary.*

"Our so-called 'hard' roads, built of brick or concrete are often claimed as permanent construction, but we have in this county brick roads and streets built less than a decade ago that are almost impassable and must soon be rebuilt. New material will be required because the old brick cannot be used again.

"On the other hand, when a Tarvia road wears, a little stone is added, Tarvia is applied, and the road is as good as, or better than, new.

"With proper maintenance, our Tarvia roads will last ten to twenty years. The cost of maintenance will be small and the entire road can be rebuilt at less than half the cost of a brick pavement.

"Considering the various types of road from a purely financial standpoint, one does not need to be skilled in higher mathematics to arrive at the correct answer." (Signed) S. Horace Weber,
*County Surveyor.*

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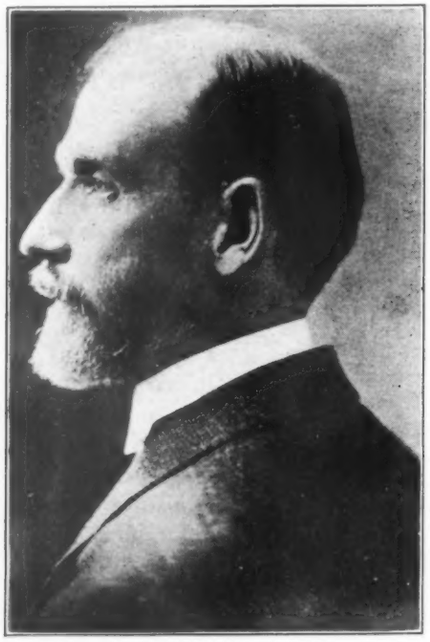
TRADE B MARK

## Frederick H. Newell Elected President of American Association of Engineers

F. H. Newell, head of the Civil Engineering Department at the University of Illinois, was elected president of the American Association of Engineers at the annual convention held in Chicago in May. He is widely known as a public-spirited engineer. He has done much for engineering and for engineers. He has been called "father of the U. S. Reclamation Service," of which he was first chief engineer (1902-07) and director (1907-14).

He has had a most active part in all of the reform movements in the engineering profession in the last few years, from the organization meeting of the American Association of Engineers in Chicago in the fall of 1914 to the conference for promoting the Department of Public Works called by Engineering Council late in April of this year. He has served as president of the committee on engineering co-operation from its organization in Buffalo in 1915 to the present time. He was one of the founders of the Washington Engineering Society and served as its president. He is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers, Western Society of Engineers and was one of the original members of Engineering Council.

Mr. Newell graduated in 1885 at the Massachusetts Institute of Technology and after field experience in Colorado and other states was appointed on Oct. 2, 1888, as Assistant Hydraulic Engineer of the U. S. Geological Survey. He actively



FREDERICK H. NEWELL, President AMERICAN ASSOCIATION OF ENGINEERS.

assisted in the preparation and public presentation of various congressional bills, one of which by the personal efforts of President Roosevelt became the Reclamation Act when signed by the latter on June 17, 1902. Immediately after that date Mr. Newell was apopinted Chief Engineer, under Charles D. Walcott, then Director of the U. S. Geological Survey.

During the next few years the organization of the Reclamation Service was completed and plans outlined for extensive work in each of the western arid states, work being initiated on most of these. In 1907 the Reclamation Service was organized as a separate bureau of the Department of the Interior, with Mr. Newell as director.

Speaking of the work of Mr. Newell, Theodore Roosevelt said: "For fourteen years I have followed at first-hand the work of Mr. Frederick H. Newell. I speak from my personal knowledge when I say that he was most loyal and disinterested. He is a public servant of whom it is the bald and literal truth to say, that by his services he has made all good American citizens his debtors."

Mr. Newell has written quite extensively on the problems of development and use of the resources of the country, his principal books being upon irrigation, the public lands and related subjects, notably The Public Lands and their Water Supply.

## Personal Items

M. W. Watson was appointed State Highway Engineer of Kansas, to fill the vacancy caused by the resignation of W. S. Gearhart. Mr. Watson has been acting in the capacity of State Highway Engineer since July 15, 1918, when Mr. Gearhart resigned to enter the army.

Mr. Watson is a graduate civil engineer of the Ohio University. He has practiced engineering in connection with coal mining, railroad work and municipal work in Southeastern Ohio, has served in a civilian branch of the United States Army Engineers in connection with the improvement of the Ohio River. Previous to entering the service of the Kansas Highway Commission, Mr. Watson served for five years with the Illinois State Highway Department, from which employment he resigned to accept the position of road engineer with the Kansas Highway Commission, when it was created in the Spring of 1917. He served in the position of road engineer from 1917 until his appointment of acting State Engineer. Mr. Watson is an associate member of the American Society of Civil Engineers, and a member of the Kansas Engineering Society.

J. W. Howard, C. E., E. M. has finished serving in the Ordnance Department of the army and has resumed the practice of his profession as consulting engineer on roads and pavements, with testing laboratories in Newark, N. J., and office at No. 1 Broadway, New York.

## Obituary

Captain Henry B. Sauerman, who was one of the organizers of the first company of army engineers in the state of Illinois, died at his home in Chicago on May 20. Captain Sauerman was born at Crown Point, Ind., April 7, 1879, and came to Chicago when a young man. After obtaining his education at Chicago technical schools and the Michigan Military Academy, Orchard Lake, Mich., he entered the employ of Fairbanks-Morse & Co., where he remained for 11 years, first as chief draughtsman and later as contracting engineer. In 1911 he joined his brother, John A. Sauerman, in organizing the firm of Sauerman Bros., engineers and manufacturers. When the original Company A, Corps of Engineers, I. N. G., was formed on Aug. 1, 1911, he enlisted for three years as a private, being elected captain on July 30, 1912, and remaining in command of the company until poor health compelled his retirement at the end of his period of enlistment. From Company A grew the 108th Regiment of Engineers, which has just returned after giving valiant account of itself on the fighting front in France and Flanders. Captain Sauerman was a member of the American Society of Civil Engineers, Western Society of Engineers and Chicago Engineers Club. In 1918 he was awarded the Octave Chanute Medal by the Western Society of Engineers for his paper "Fortification," which was prepared for a meeting of the society in 1916 and later published as a handbook for army engineers. His booklet entitled: "Highways and Railways for the Defense of Our Nation," recently published, which is an extract from a paper written by him in October, 1916, has been accorded very high praise and is in great demand at this time. On this subject he was among the pioneers.

# WATER WORKS SECTION

## Advantages of Combined Operation of Water and Electric Utilities and Selling Electric Current for Private Use in Springfield, Ill.

*By Willis J. Spaulding, Commissioner of Public Property, Springfield, Ill.*

After the experience of the past ten years in the operation of the water works and electric plant in Springfield, Illinois, and observation of many other similar enterprises, I feel warranted in stating the two following propositions as being of general application, subject to exceptions, of course, due to unusual conditions:

First, if a city is generating electric current for lighting its streets, it cannot afford to turn the commercial field over to a private company. Second, where steam is the motive power, if the city owns both water works and electric plant, either they should be combined (the pumping station and electric generating station) or the pumping should be done electrically so as to avoid maintaining two steam boiler plants.

*Commercial Light and Power.*

As to the first proposition, commercial light and power was being supplied in Springfield by a private corporation their rates being such as are commonly charged in cities of its size (60,000): The city's rates including power users and all other classes of consumers average 35% to 40% less than the rates of the private company.

Our lighting rates are 6 cts. for the first 30 K. W. H. used in one month, and 3 cts. for all over. Power rates 1 ct. per K. W. H. plus a service charge of $100 per K. W. H. for the first 10 K. W. of active connected load and 50 cts. per K. W. for all over. Cooking rates 2.2 cts. All rates subject to a discount of 10% for prompt payment.

The city plant has acquired about 25% of the commercial business and could have it all if it were not for the legal difficulties in the way of financing the enterprise. If the city plant was supplying all the commercial business at the present rates there would be left in the pockets of light and power users approximately $150,000 a year while at the same time the plant would be earning a surplus of at least $100,000 annually.

*Advantages of Combined Water and Electric Plants*

As to the second proposition there are many economies to be gained in operating one plant as against two. In our case, after shutting down the old electric plant and consolidating it with the water works, the tons of coal used for operating both utilities was almost exactly what it has been for operating the electric alone. This was largely due to the substitution of condensing turbines for reciprocating engines exhausting in atmosphere.

We found the same crew of men which were required for operating the pumping station alone, was sufficient to operate both utilities. This gain, however, was offset to some extent because of the fact that it was necessary to maintain an electric sub-station which was not required when the plants were operated separately. After allowing for this offset we still had a saving of $5,000.

The year ending Feb. 28, 1915, which was the last year the two utilities were operated separately, the total operating expense was $104,694. The first year after consolidation it was $88,805, showing a saving of $16,889. This saving, however, does not reflect the full advantage gained because during the year after consolidation the combined plant not only supplied all the electric current for street lighting and other public uses as it had the year previous but also produced additional current for private use which brought additional revenue of over $20,000. Making allowance for this additional output, I think it would be conservative to say that the total saving amounted to not less than $20,000 per annum.

In relation to city government attention is generally centered on taxes. This is partly due to the natural tendency of those seeking office to call attention to alleged extravagance of the officeholders whom they seek to displace, and on account of this constant exaggeration I think it is fair to say that the average citizen has a very distorted view as to waste incident to the discharge of public functions.

In contrast with the assumed extravagance of public administration, it might be well to reflect that municipally owned and operated water works and electric plants almost universally supply much more service for the money collected than do private companies under similar conditions, which are assumed (often erroneously) to be very efficient. The relative importance of public utility charges from the standpoint of the city government is overlooked. The city of Springfield would, I take it, furnish a fair example in this regard.

*Swallowing a Camel*

During the present fiscal year our city government will expend from money received from the citizens as taxes and licenses, a total of about $425,000. During the same period the residents of this same city will have paid out for public services suplied by those public utilities which are privately owned (omitting telephone and telegraph) $1,500,000 or nearly four times the amount levied and collected by the city government. These utilities include street railway, gas, electric light and power, and heat, each of which furnishes to the people living in the city, services which are as much public in their nature, and just as necessary to the welfare of each resident as are our public libraries, paving, sewerage, fire and police protection, etc. When we split hairs over our tax rate and overlook this larger item, are we not "straining at a gnat and swallowing a camel?"

*Earnings*

The total gross earnings of the combined water and light plants for the fiscal year ending Feb. 28, 1919, amounted to $217,238.87; the total operating expenses $124,941.11 leaving net earnings $92,297.76.

After making deductions of $25,200 for "depreciation" to make good the estimated wear or deterioration of the property during the year, a surplus remains of $67,097.76.

The figures presented separately are as follows:

*Water Department*

| | |
|---|---|
| Gross income | $140,093.09 |
| Operating expense | 75,734.49 |
| Net revenue | $ 64,358.60 |
| Depreciation | 20,040.00 |
| Surplus | $ 44,318.60 |

The city pays nothing for water for public uses although all services are metered where practicable to account for the water used and to prevent waste.

There were in service at the beginning of the fiscal year

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868 fire hydrants. Charging these to the city at $40 a year, would amount to a total of $34,720, which is a fair estimate of the value of free service. This item is entirely omitted in the above figures, and if included would increase our surplus to over $79,000.

*Light and Power Department*

| | |
|---|---|
| Gross income | $ 77,145.78 |
| Operating expense (including item of $3,385.00 rent to water department on equipment used jointly | 49,206.62 |
| Net revenue | $ 27,939.16 |
| Depreciation | 5,160.00 |
| Surplus | $ 22,779.16 |

The water, light and power department follows the uniform system of accounts as outlined by the State Utilities Commission for private utility corporations.

The increase in operating expense in the water department over the previous year due to the war amounted to 21.5%. There was a decrease in revenue during the same period of 2.7%.

The increase in operating expenses in the light and power department amounted to 27.1%, but this was entirely offset by increased earnings. Rates have not been increased in either department.

*Plant Extension*

Because of lack of funds it is impossible to make electric extensions as fast as they are demanded. Pole and wire extensions to new consumers are made where persons interested in securing the service advance sufficient money to pay for the cost of material and apparatus required, such advances being returned in service. About 1,000 customers have been taken on in this way. Total cost of additions and extensions last year was $27,367.72. Money for building a utility plant in its infancy is usually provided by the sale of bonds but we are getting along as best we can without borrowing.

Growth of the commercial business in the light and power department is shown in the following table (street lighting is excluded):

| Year ending | K. W. H. Supplied | Number Consumers | Gross Revenue |
|---|---|---|---|
| February 28, 1916 | ..... | 286 | $10,972.00 |
| February 28, 1917 | 1,142,758 | 806 | 29,574.26 |
| February 28, 1918 | 1,342,892 | 1308 | 40,072.17 |
| February 28, 1919 | 1,796,966 | 1803 | 50,635.06 |

Power business has grown steadily. We now have over 700 horse power in motors connected. A number of electric stoves have been placed in service and have given complete satisfaction. A special rate of 2 cts. net per K. W. H. is made for cooking which makes the cost no more than for gas, while the electricity is safer and better.

*Financial Benefits Derived*

The financial benefits for the year accruing to the people of Springfield on account of combining the Municipal electric plant with the water works and entering the commercial field are summarized as follows:

| | |
|---|---|
| Surplus earned | $22,779.16 |
| Saving in street lighting | 10,000.00 |
| Saving by 1,803 consumers, account of the difference between the company and city rates | 30,000.00 |
| Reduction by private company from 13 to 11 cts. due to movement to establish combined city plant | 25,000.00 |
| Total annual saving | $82,779.16 |

Moreover the low rates offered by the city have induced many citizens to wire their homes and become electric users, thus bringing this great convenience more nearly within the reach of all. We have connected at least 150 of such customers the last year.

## Design of New Filters Influenced by Experience Gained from the Operation of Original Filters at the Minneapolis Plant

*By Lewis I. Birdsall, Superintendent of Purification Division, City Water Department, Minneapolis, Minn.*

The demand for filtered water in Minneapolis has far exceeded the estimates of the engineers who designed the original water purification plant. The two coagulation basins and twelve filters put in service in January 1913 had a rated capacity of 39,000,000 gals. daily. Two coagulation basins and four additional filters were constructed during 1914 and 1915 which gave the plant a total rated capacity of 52,000,000 gals. per day. It was found necessary in 1917 again to increase the capacity of the plant. Eight new filters are at the present time nearing completion and will be ready for service during the hot weather of 1919. Two more coagulation basins are under construction and when these are completed the plant will have a total rated capacity of 78,000,000 gals. daily.

Experience gained from the operation of the twelve original filters pointed out necessary changes in the design of the four filters built in 1915 while more recent experience has led to further changes in the design and equipment of the eight new filters.

*Filter Bottom Troubles*

This subject was discussed in a paper presented by the writer at the Richmond meeting of the American Water Works Association.*

It was there pointed out that failure of the Tobin bronze strainer plates and bolts in the Minneapolis filters was due to lact of proper annealing of the metal after it had been cold worked. Proper annealing of the metal practically eliminated these troubles and very few failures have occurred since.

Strainer plates and bolts made of medium brass did not crack as did the Tobin bronze but the brass plates bent out of shape easily and so it was thought best not to use the medium brass in new installations. Monel metal plates and bolts installed as an experiment in one filter in 1914 have shown no failures whatever. It was therefore decided to use monel metal plates and bolts in the eight new filters. The cast monel metal eye bolts and nuts were made at the factory, while the strainer plates were cut, drilled and shaped on the job by an experienced sheet metal worker.

The strainer plates in the original filters rested on shoulders formed in the sides of the concrete ridge blocks, neat cement being used to seal the openings between the plates and the blocks. Experience demonstrated that the concrete shoulders broke down in time partly from action of the water but more especially due to the chisels of the workmen whenever it was necessary to remove a plate. Mr. W. N. Jones, engineer in charge of filter design and construction, has therefore installed in the new filters cast iron plates, having machined shoulders to receive the edges of the strainer plates. These cast iron plates serve as lateral forms for the base of the ridge blocks which are poured in place. Red lead is used to seal the joint between the strainer plates and the cast iron shoulder. Whenever necessary the strainer plates may be easily removed without damage to the ridge blocks. The strainer plates are held in place by monel metal eye bolts through the eye of each bolt there being a monel metal rod supported in notches cast in the iron plates.

The underdrains of the original filters consisted of 20-in. cast iron pipe from which there were four 14-in. risers on the center line of each half of the filters. A central passageway

*Some Practical Problems in Filtration Plant Operation, by Lewis I. Birdsell. Journal of the American Water Works Association, Vol. 4, No. 4, December, 1917.

underneath the strainer plates extended longitudinally of the filters and from this the lateral passages extended between the ridge blocks. It was found that most of the breaks in the strainer system of the old filters occurred over or near the 14-in. riser pipes. In all of the later filters this arrangement of the collecting system was eliminated. The 20-in. pipes are now cast in manifold form with a 3-in. riser between each pair of ridge blocks which are now made continuous across each half of the filter, there being no connection longitudinally of the channels formed between the blocks. This arrangement has worked very satisfactorily and has given an excellent wash in the four filters put in service in 1915.

It has been found by experience that notwithstanding the greatest care on the part of those in charge of the filter construction work much debris accumulates in the underdrains during the construction of the filters. When the original filters were put in service an ordinary blow torch which had washed from the underdrains into the filtered waste valve could be removed only by taking the valve apart. Chunks of concrete and other debris lodged in other valves and caused trouble. In order to eliminate these troubles in the new filters the 20-in. collector pipes are now extended through the wall into the pipe gallery where the ends of the pipes are closed with blind flanges. It is now a simple matter to inspect and clean these pipes at any time.

Auxiliary clear water basins were not built under the twelve filters last constructed because of the ample storage capacity (45,000,000 gals.) for filtered water already existing. It was considered of more importance to have dry wells under these filters so that the collecting pipes might be accessible for frequent inspection and for painting.

*Filter Valve Troubles*

Much trouble has been experienced by leakage through the wash water valves of filtered water from the wash water tank. This water is not wasted unless the filters are out of service but with considerable leakage the wash water pumps are kept busy keeping the tank full. The wash water valves on the original filters and also on the four filters built in 1915 are 24-in. hydraulically operated double disc gate valves placed with the stem horizontal and the discs vertical. The discs are faced with bronze rings which seat against bronze rings in the body of the valve. Investigation has shown that the frequent opening and closing of these valves under a pressure greater on the wash water tank side has caused the discs to bind on the bronze seat rings on the filter side of the valves, thus scoring the seat rings at the top and bottom. It was impossible to remove the rings without injury to them as the lugs had all been removed before the valves were received from the manufacturer. Otherwise the rings might have been refaced and returned to place.

Similar trouble was experienced with several of the 30-in. hydraulically operated sewer valves but on investigation it was found that the discs had either opened too far and in closing had caught and torn loose the seat ring or else some hard foreign body had lodged between the discs and the rings and caused the damage. The latter explanation did not seem logical in view of the way in which the valves were set and the large opening of the valve.

New seat rings were ordered from the manufacturers but when these were received it was found that the rings were not of standard size, in fact no two valves of the same size appeared to have the same size of seat rings. It was necessary to caliper each ring seat carefully and have the rings machined to fit. The engineer in charge of filter construction has stated that these valves were ordered under specifications which required that all valves of the same size should have their parts interchangeable. It would appear that the valve manufacturers do not deem it important to use a standard size of seat rings in their valves even though it means much to those who use them.

Specially designed and constructed hydraulic valves for the wash water and sewer lines of the eight new filters were ordered at an additional cost, which, however, appeared to be justified in view of previous experience. These new valves have lugs attached to the discs in such a manner that the discs travel on tracks and rollers so arranged that the discs cannot bear against the seat rings until the moment that the gate seats. It it hoped that these new valves will be free from the difficulties previously encountered.

*Trouble with Hydraulic Control of Valves*

All of the valves connected with the Minneapolis filters are hydraulically operated from operating tables. The necessary water pressure is obtained from an elevated tank, and amounts to a 50-ft. head at the manifold of the operating tables. The piping from the manifold of the operating tables to the hydraulic cylinders on the valves is ¾-in. in the case of the twelve original filters. It was found that the wash water and sewer valves required approximately six minutes for opening or closing. When the four additional filters were built larger four-way cocks were specified for connecting with 1-in. pipes leading to the hydraulic cylinders of the wash water and sewer valves. This change resulted in the valves opening and closing in about one-half the time, but still too slowly to be satisfactory.

The installation of a pressure pump would have given sufficient pressure to operate the valves rapidly at all times and in fact such a pump was installed for opening valves which stuck. It was desirable, however, to be able to operate all of the filter valves with the elevated tank pressure as the electric power supplied to the plant often kicks out during heavy thunder storms. Therefore, 1½-in. pipe connected to special four-way cocks of the same size were installed on the operating tables of the eight new filters. The result has been highly satisfactory, the wash water and sewer valves opening and closing in less than one minute. The amount of wash water saved through a quick opening of the valve has not been calculated, but it undoubtedly amounts to a large quantity in a year.

*Electric Versus Hydraulic Effluent Control*

Electrically operated automatic effluent controllers were installed on the first 16 filters, but experience has shown that electric control is unsatisfactory at certain times, especially when the power kicks off during electric storms. Also the habit acquired by some of the motors to run wild and open wide the butterfly valve on the controller unless observed in time, causes constant worry to the operators. The electrical apparatus exposed as it is in the pipe gallery to constantly moist air requires considerable supervision and maintenance.

The eight new filters have been equipped with hydraulically operated effluent controllers to obviate the above mentioned difficulties. All of the controllers are connected with a master controller operating in such a manner that the rate of filtration of each filter can be automatically controlled between maximum and minimum rates as predetermined and the rate varied automatically according to the level of the water in the clear water reservoir.

The chlorine machines now being installed in duplicate for the new filters are designed to operate automatically in proportion to the rate of filtration. The chlorine machines may, however, be manually controlled if so desired.

Other changes in the plans of the new filters have been the installation of an extra wash water gutter in each half of the filters so as to decrease the lateral travel of the dirty wash water and the filling up with cinder concrete of a portion of the rear end of the central gutter of each filter so as to save the wedge of water that is otherwise wasted each time that the gutter is emptied for washing of the filter.

## Chlorination of Swimming Pool Water

"Chlorination of swimming pools is apparently highly efficacious," says C. G. Gillespie, director of the Bureau of

Sanitary Engineering, California State Board of Health. "Where it is employed in connection with a circulating system it appears to impart a prolonged disinfecting property to the pool water which is able to cope with the pollution subsequently added as a result of bathing. The explanation of the longer duration of the action in swimming pools than in drinking water supplies may be that the organic matter in the swimming pool forms, with chlorine, the 'chloramie compounds' which have been shown to give slower but far more lasting results than the free chlorine itself. Ordinarily, 0.5 lbs. of chlorine per 100,000 gals. of water added is sufficient for swimming pool disinfection. The chemical may be added in the form of chlorine gas, in which case a chlorinator apparatus is used, or it may be used in the form of bleaching powder mixed into a solution and fed into the supply at a rate proportionate to the flow. Bleaching powder is weaker than the chlorine gas by about 70 per cent, therefore about three times as much, or 1.5 lbs. per 100,000 gals. must be used. Works for the handling of bleaching powder consist of a concrete tank holding about 300 gals. and a small concrete orifice tank for regulating the feed of the solution, besides appurtenant piping. In either case the chemicals may be applied at any point in the circulating system.

"Existing pools not equipped with a circulating system may easily provide for disinfection of incoming water by either of these means and largely fortify the pool water against contamination. In pools where the supply of water is particularly low, considerable benefit may also be obtained by splashing the bleaching powder solution evenly over the entire pool just as the bathing stops, so that the wave disturbance may tend to diffuse the chemical throughout the depth of the pool and to disinfect it."

## How Vinton, Iowa, Obtained a Dual System of Water Supply

*By J. H. Dunlap, Associate Professor of Hydraulics and Sanitary Engineering, College of Applied Science, State University of Iowa, Iowa City, Iowa.*

### *The Domestic Water Supply*

By drawing its domestic water supply from wells reaching to the Jordan sandstone, 1,400 ft. below the ground level, and by utilizing the water of the Cedar river flowing just at the rear of the water works pumping plant, the city of Vinton, Iowa, has been able to provide pure water for domestic consumption and also a much softer water for manufacturing purposes. To accomplish this, two separate distribution systems and two separate pumping systems were necessary. While neither the well water nor the river water is as soft as is desirable, yet it is a great advantage to the industrial prospects of Vinton to have the 561 parts per million total solids in the deep well water reduced to less than 228 parts, which is the mineral content of the Cedar river at Cedar Rapids, some distance below Vinton.

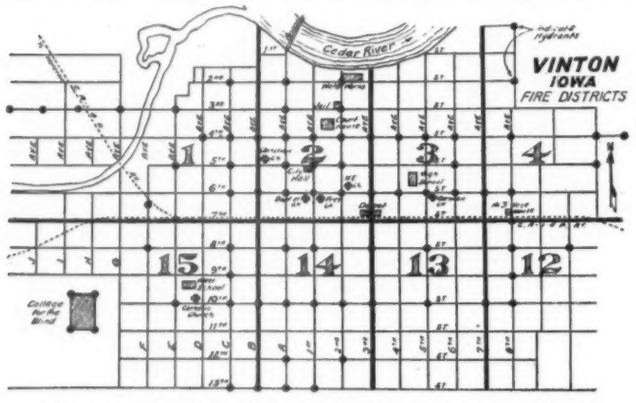


FIG. 1—VINTON, IOWA, SHOWING THE LOCATION OF THE WATER WORKS AND FIRE HYDRANTS.

### *Deep Wells and Air-Lift Pumps*

With a population in 1915 of 3,996, Vinton lies at the extreme western limit of the area in which the quality of the water obtained from the Jordan sandstone is suited to domestic use. Nevertheless, the well water is so hard that it would be very costly for manufacturing use, and would greatly handicap the city in its future industrial development. It was in 1890 that Vinton turned to deep wells for its source of supply after having some experience with shallow wells. There are now two wells, one 1,297 ft. deep, one 1,410 ft. deep. The first well is 5 ins. in diameter at the top and 4 ins. in diameter at the bottom, while the second is 5 ins. in diameter throughout. Each well has 610 ft. of casing and cost complete with the casing $5,300. Originally the wells were flowing wells, but now

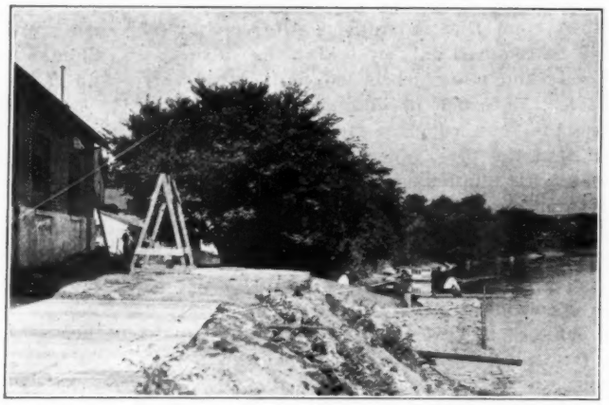

FIG. 2—LEFT TO RIGHT: THE WATER WORKS PUMPING PLANT, THE INTAKE WELL, THE INTAKE AND THE CEDAR RIVER.

the water will rise only to within about 8 ft. of the ground surface. By using air-lift pumps each well is made to yield 250 gals. per minute.

In July, 1917, while on an inspection trip for the Iowa State Board of Health, the following facts were noted.

About 80 per cent of the population were reached by the water mains. The number of service accounts was 750 with 735 of them metered. It was estimated that the domestic consumption of well water was 100,000 gals. per day. It is interesting to add that in addition to this the industrial and manufacturing use was 120,000 gals. per day of river water.

### *Air Lift Equipment*

The deep wells are pumped by two air-lift pumps each connected to the same air receiver. A new Ingersoll-Rand single stage 10x10 in. air compressor is belted to an overhead Westinghouse motor of 35 h. p. at 220 volts and 1,150 r. p. m. The air receiver is 6 ft. high by 2½ ft. in diameter. In addition to the new compressor an older one is kept in reserve. The pressure to start the air-lift pumps is 120 lbs. per sq. in., which drops to 90 lbs. when pumping begins. From the air receiver a 2-in. pipe runs to the farther well, and a 1½-in. pipe to the nearer well. These air pipes extend down 250 ft. into the wells, ending in Harris air-lift foot-pieces. The air-lifts pump the water into a surface reservoir of 40,000 gals. capacity.

From this surface reservoir a motor-driven Union 3-in. centrifugal pump throws 300 gals. per minute at a head of 176 ft. into an elevated steel tank on a steel tower 160 ft. high. The motor is an induction motor of Westinghouse manufacture, 25 h. p. running at 220 volts and 1755 r. p. m. The air compressor and motor cost $1,222 in 1917 f. o. b. Vinton, the centrifugal pump $108 and its driving motor $462.

### *Distribution System.*

The distribution system for the domestic water supply consists of nine miles of 10-in. to 4-in. cast iron pipe. There are 71 fire hydrants with 51 gate valves on this system. The

elevated tank has a capacity of 70,000 gals. For fire protection a Gardner fire pump is used. This is a simple, duplex pump 18 x 10 x 12 ins., rated at 1,200 gals. per minute at a piston speed of 141 ft.

*Pressure*

The domestic pressure maintained at the pumping plant is 68 lbs. per sq. in., which is increased in time of fire to 110 lbs. per sq. in. There is very little loss of head in the distribution system under ordinary conditions, since the town lies so close to the pumping plant. The maximum difference in elevation between the pumping station and the highest part of the town is about 25 ft.

*Water Rates*

The following rates are charged for this deep well water:

40 cts. per 1,000 gals. for the first 5,000 gals.
35 cts. per 1,000 gals. for the next 5,000 gals.
30 cts. per 1,000 gals. for the next 10,000 gals.
20 cts. per 1,000 gals. for all over 20,000 gals.

Meters are read in April, August and November with a minimum of 50 cts. per month.

*The Industrial Water Supply System*

In contrast with this domestic water supply it is interesting to compare the separate distribution system used to carry the water directly from the Cedar river to the railroads and factories. This river distribution system consists of about 1⅛

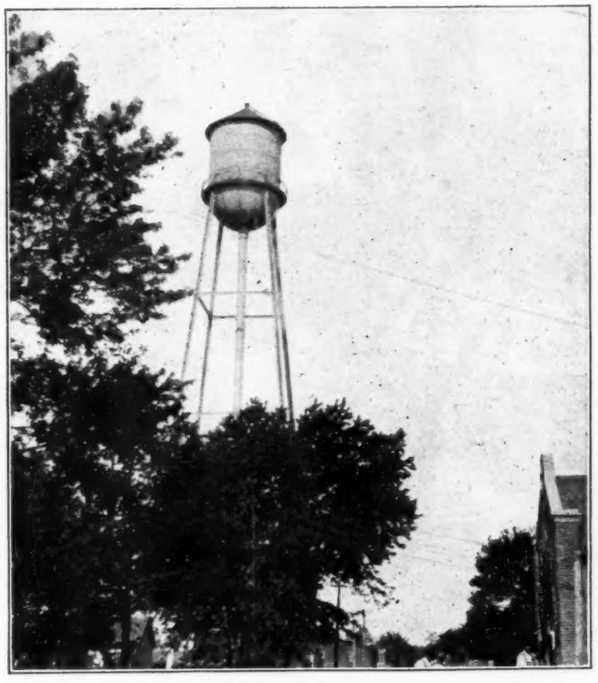

FIG. 3—THE ELEVATED STEEL TANK OF THE VINTON, IOWA, WATER WORKS. HEIGHT, 160 FEET; CAPACITY, 70,000 GALLONS.

miles of 4-in. cast iron pipe. The intake is in the Cedar river immediately at the rear of the pumping station. The water receives no treatment, but its mud content settles out to a considerable extent in a large intake well. From the intake well a simplex Union tandem-compound steam pump, 12 x 18 x 12 x 16 ins. pumps directly into the river distribution system.

The river water is sold at a uniform rate of 8 cts. per 1,000 gals.

While not many cities are so situated that a dual system of water supply is possible, it has proved in the case of Vinton to be well worth while to take advantage of local opportunities in this respect.

## Features of the Well System of the Dayton, Ohio, Water Works

*By H. C. Wight, Superintendent Division of Water, Department of Public Service, Dayton, Ohio*

Dayton is fortunate in having a water supply from wells which have not only proven sufficient in the past, but seem adequate for future development. The water is close enough to the surface to be pumped by direct suction, thus eliminating deep well troubles or air-lift expense. A supply of this type is worth much to a city. The water leaves the pumps at 61 degrees in the summer time and at 58 degrees on the coldest winter days. Its quality is excellent, samples for the last month averaging 9.4 bacteria per cubic centimeter without treatment or artificial filtration. It costs little more to secure than unfiltered lake water, which, of course, is not as desirable in these days of sewage problems.

A number of years ago the adequacy of the local well system was questioned. Today we are pumping more water with less trouble, principally due to minor changes and necessary repairs. The average consumption per day is 15,000 000 gals., and more than 20,000,000 gals. have been delivered on a number of days, at rates of pumpage varying from ten to forty million gallons. A large equalizing reservoir was completed in 1918, and serves to remove the peak loads which came on summer afternoons when the people sprinkled their lawns. Instead of opposing the use of water for sprinkling, as many cities have done, Dayton has gone on record as favoring it, as we have the water and make a profit on each gallon sold.

*Four Groups of Wells*

The water is secured from four groups of wells. The first, or old group, is located in Mad River, near the pumping station, and contains 96 wells, though many of these are poorly spaced and of little value. The second, or Aqueduct group, is located just east of the main group and contains 6 wells. It is pumped by a low- lift centrifugal pump and yields 3,000,000 gals. per day. This group was developed in 1910. The third group is located 13,000 ft. east of the main group and connected thereto by a 36-in. iron conduit. It contains 27 wells and is pumped by two 5,000,000 gal. electric units, which when operated singly have a capacity of 6,000,000 gals. each. This group was completed in 1915 and is called the Tate's Hill group. We are just now completing a fourth set of ten wells, 1 500 ft east of the third group. These wells have been the most remarkable of any on record.

Just south of Mad River and between the first and second sets of wells, an artificial basin existed built originally for making ice. This pond has been divided into three acre groups and can absorb more than 10,000,000 gals. a day. The amount of the water which filters through and reaches the city supply is probably small as the normal flow of the ground water is to the southwest. It is very possible that the down filtration takes the place of the normal flow which has been stopped more or less by the draught of the wells. This pond is flooded by gravity from the Miami and Erie Canal Feeder or by a 10,000,000 gal. unit which takes its suction from the Mad River.

All of the water from the electric stations goes to the main plant where the pressure is raised to the desired amount. We have two services one of 75 to 80 lbs. and the other of 130 lbs. The high service load is equalized by means of a 900,000 gal. stand pipe.

*Overcoming Air Trouble*

Well water contains a certain amount of air. Unless this water flows to a reservoir by gravity, this air will cause trouble when pumped. All water works men are familiar with occasional leaks in the pressure mains. They are not always as familiar with suction leaks which cause more trouble and are harder to locate and repair especially if the leak is in the well pipe or in covered mains. A lot of our air trouble has

# CONTINUOUS

*A story of long*

THE FIRST CAST IRON PIPE EVER MADE IN
STORY IS STILL IN SERVICE
SERVICE
CAST IRON PIPE
MEASURED BY
CAST IRON PIPE
CENTURIES
MORE THAN 250 YEARS OLD

The Cast Iron P

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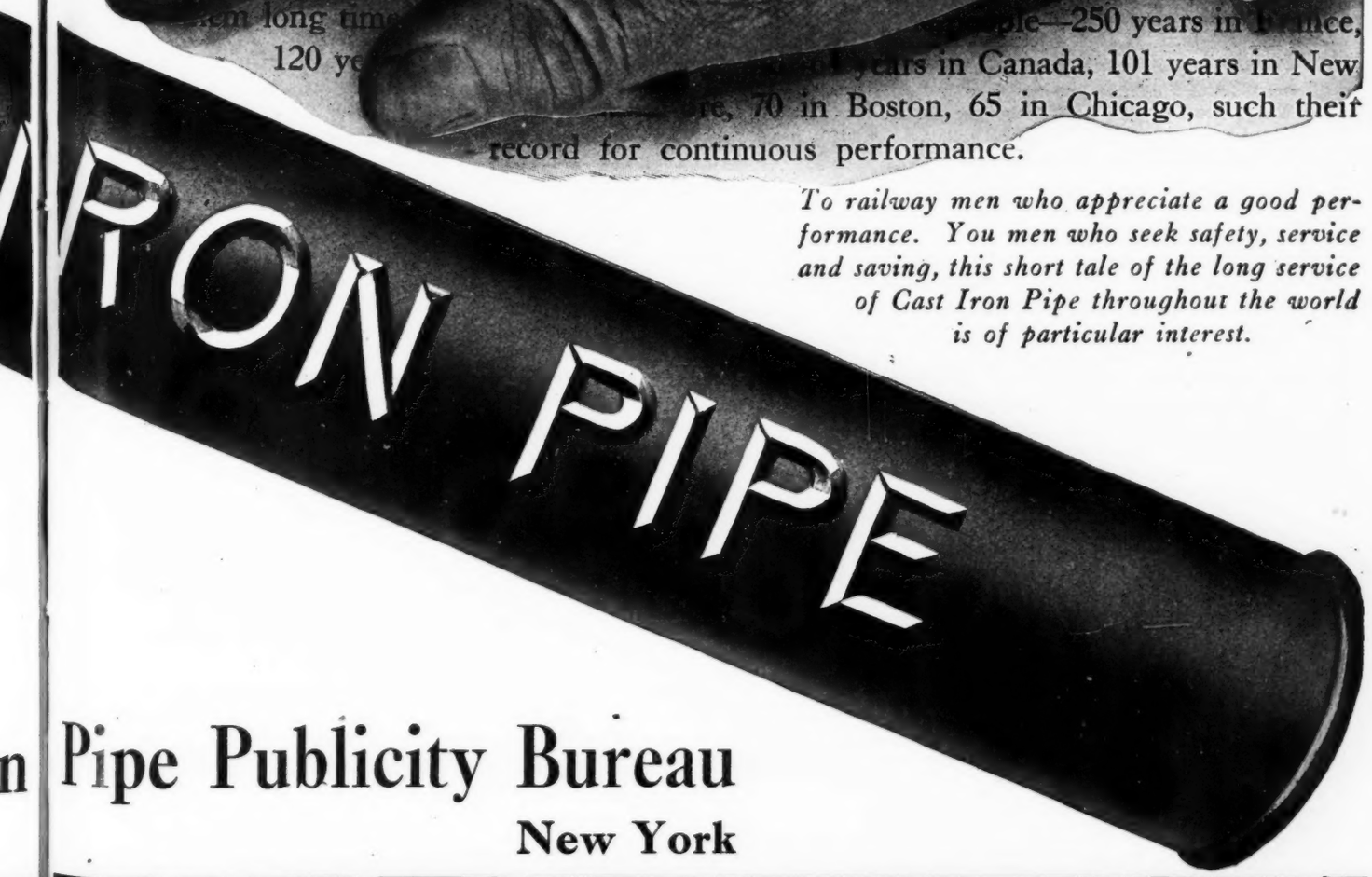
# PERFORMANCE

## *time on the big circu*

THIS is no tale of
in the life of pi
short engage
The fact is
—throu

ce has
em long time
ple—250 years in
120 ye
ears in Canada, 101 years in New
re, 70 in Boston, 65 in Chicago, such their
record for continuous performance.

*To railway men who appreciate a good performance. You men who seek safety, service and saving, this short tale of the long service of Cast Iron Pipe throughout the world is of particular interest.*




**Pipe Publicity Bureau**
**New York**

been overcome by removing the air by means of air chambers and vacuum systems. These remove air from all of the high points on the system and keep the air from the pump chambers.

The future development of the Dayton water system will probably be around wells. The individual groups may possibly be kept below 10,000,000 gals. daily capacity. The underground vein of water which is tapped passes under about half of the city. Well systems are often scrapped on account of difficulties which might easily be overcome. If well water is obtainable, it is worth much both to the people supplied and the producing water company.

## Reduction of Water Consumption by Means of Pitometer Survey and Constant Inspection at Buffalo, N. Y.

*By George C. Andrews, Water Commissioner, Buffalo, New York.*

In 1897 the Buffalo Common Council decided it more advantageous to its citizens to install more pumps and give practically an unlimited supply of water than to control consumption by means of meters. It is hardly necessary to add that this decision was made contrary to sound engineering advice. Free water is a slogan that often appeals to the unthinking. It would be interesting to speculate on what that decision has cost the citizens of Buffalo in the past 22 years. Suffice it to say that in 1903 the Bureau of Water had a bonded debt of $3,699,382, while it was $12,141,524 in 1917. From that date until 1917 it was a race between the unchecked waste both in mains and in houses and the pumps.

In 1903 there was one pumping station with a daily capacity of 183,000,000 gals. In 1917 there were two pumping stations with a combined daily capacity of 330,000,000 gals. Coincident with the increased pumping capacity large distributing mains were laid. During this period the per capita consumption had ranged between 302 and 339 gals. per day. Of this practically 100 gallons was for industrial use.

### *Pitometer Survey of Small Section Made to Test Value of Method*

In 1916 the city government was altered and a commission of five men elected to govern the city. Their platform was an economical and efficient city government and one of the early efforts was an investigation as to means to reduce the city water consumption. As all water used must be pumped from Lake Erie against a head of 140 to 204 feet, a reduction in pumpage would make an immense saving in coal used for fuel. Various methods were considered and in the Spring of 1917 it was decided to have a pitometer survey made of a small section of the city with the idea of covering the whole city later should this section show satisfactory results. The question of metering was considered but rejected on various grounds, some of which were: popular local prejudice against metering, length of time to completely meter city, there being over 76,000 unmetered and active services, while the pitometer method promised early results; extensive changes in plumbing required should meters be installed in many of the poorer types of dwellings, heavy initial investment required for meters.

### *City Divided Into Ten Sections*

To facilitate the work and also that definite records could be obtained of water consumption in different points, the city was divided into ten sections none of which were similar in character and work completed by sections.

Section 1 included manufacturing use, poor, good, and high grade residential districts.

Section 2 is an old residential section with most of the buildings antedating the modern sewer and water service. In this section the toilets are usually of the so-called anti-freezing type installed in a shed in the rear of the house. The waste in this section was tremendous.

Section 3 is a section of the city sub-divided in the 90's, when water mains, sewers and services were laid. This section is only now being developed. The residences built are of fair construction. In this section the rock lies close to the surface and in many streets water mains and house services are laid in the sewer trench. The value of the pitometer was proven in this section as ever-leaking unfinished supplies which were discharging into the sewers were discovered and stopped. Along Fillmore Ave., quarries had been opened years ago and water from a broken 16-in. main discharging into the face of the pit had for years furnished excellent water for men and teams working in the quarry.

Section 4 is principally high class residential, such as the Delaware Park section. Western portion, however, heavy manufacturing use of water and poor class dwellings, 75% of this section is built on rock strata close to the surface.

Section 5 is high class residential, principally, with eastern portion of middle class dwellings. No manufacturing use of water.

Section 6 takes in the heart of the business section of the city. Northern portion is composed of middle class dwellings but 80% of water is used commercially.

Section 7 includes poorer class dwellings and large manufacturing use of water. All the big packing houses and stockyards are included in this section.

Section 8 includes most of the water front of the city with large manufacturing plants and commercial use of water. Poor class of dwellings and the oldest section of the city.

Sections 9 and 10 include middle class dwelling with some large steel mills on the outskirts. Also railroad yards are large consumers in these sections.

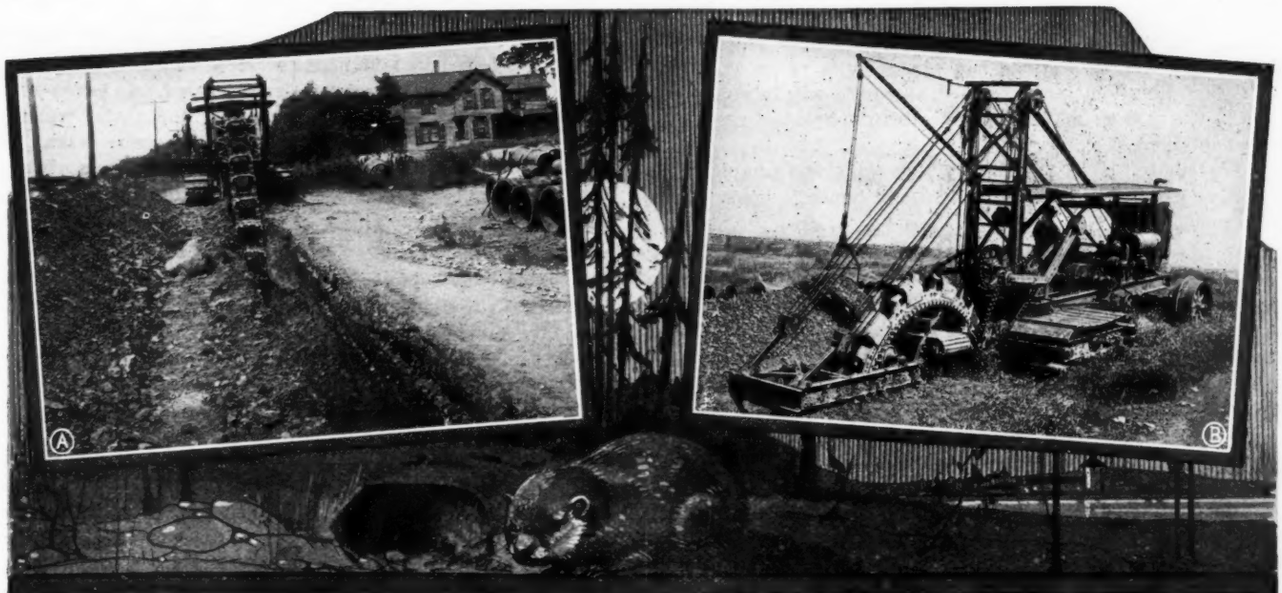
### *Theory of a Pitometer Survey*

The theory of a pitometer survey is briefly described as follows: A certain section of the mains is isolated by closing all but one of the boundary valves. A special corporation cock is inserted on the main feeding this district through the open valve. The main is traversed and the velocity of the water determined by the instrument inserted in the main through the corporation cock. Gaugings are recorded on sensitive paper for 48 hours and from the velocities shown the flow computed. As all the water entering this section passes the instrument the amount measured must be the consumption of the district. The interesting or indicating feature of these records is the relation between the minimum night rate, which is usually found between 12:00 P. M. and 3 A. M., and the total 24-hour consumption. A high night rate, unless accounted for industrially, means leaky fixtures or breaks in mains.

As the isolation of a section is apt to leave some industries just within and without the district short on water pressure causing complaints of low pressure a map is kept in the office of the Superintendent of Maintenance on which all valves closed are indicated by a red headed pin. By this means one can at a glance determine if a complaint of lack of pressure is due to the pitometer work or to some other cause. These pins for closed valves are corrected each morning.

### *Sub-Division Work*

After the total measure of a district is made, sub-division work is started. Sub-division is the determination of the consumption block by block and is always done at night. The pitometer is set at the gauging point and the district shut off block by block, the time of each shut off being noted. By comparing the time with the consumption shown on the photo chart at the corresponding time the rate for each block can be determined. This is a very important feature of the pitometer work as by comparing the consumption for the different blocks one knows immediately where the inspection of fixtures will give the greatest result. It is an especially valuable feature for the control of the house waste after a survey has once been



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B—Is a Wheel Type P & H Excavator opening the ground for a drain pipe-line. This is the outfit for pipe-line, conduit, and farm drainage excavation. Built of steel for light weight and flexibility; digs trenches 7½ feet deep to 28 inches wide.

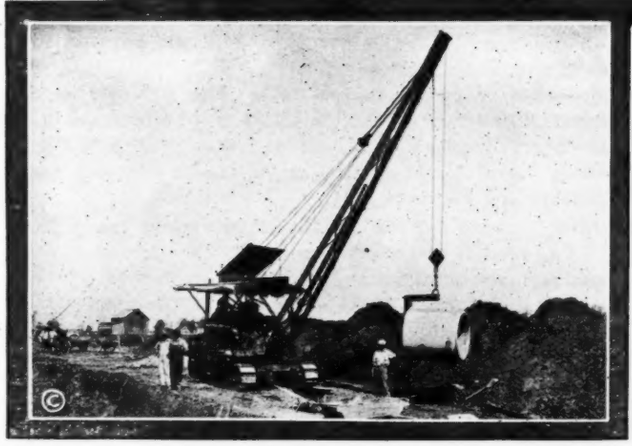
C—A machine with a multitude of uses—the 205 Dragline P & H Excavator. What it will do: Excavate open or sloping bank ditches, clean out old ditches, dig cellars and holes, strip coal, grade streets, backfill trenches, load or unload coal, crushed rock, screenings, sand or gravel, and last, but not least, it is a complete, portable locomotive crane with a lifting capacity of 3500 pounds.

D—Getting the dirt back is sometimes as troublesome and costly as getting it out. This machine makes it easy and does it in a hurry on one man's time. Just the outfit for city streets where work must be done with uniformity and dispatch. The P & H Backfiller has capacity to take care of the largest sizes of trench excavators.

*You may not need P & H Excavating Equipment right now, but write for Bulletin X and keep it handy.*

**PAWLING & HARNISCHFEGER CO., Milwaukee, Wis.**

**P&H —excavators,— backfillers, tampers.**



made. By means of the pitometer and proper sub-division, house to house inspections can give results twice as quickly as though no pitometer were used, as efforts will be confined to blocks where the sub-division indicates the greatest results are to be obtained.

Immediately after the sub-division work was completed, inspectors were placed in the district and house to house inspection made.

*Organization for Survey*

To make the survey, an engineer in charge and four assistants were employed. Three trucks with gangs of four were constantly engaged and one clerk assigned to this work to keep the records. Twelve of the regular city inspectors made the house to house inspections. Later, as more of the city was covered, 20 temporary inspectors were engaged.

One of the assistant engineers made the district measurements and two were constantly engaged on sub-division. One assistant engineer tested the meters and fire lines. During the winter months two men worked in the office.

The inspection for house waste is of great value, and a large percentage of the total waste eliminated is directly due to inspection. However, proper control must be exercised or the results will be indifferent. From 1906 until 1915, the department employed men to stop house waste, but had no control over it by means of district measurements. During this period the per capita consumption was practically stationary, although the annual consumption increased.

*Inspection Records*

As the sub-divisions showed waste in practically every block, a system of inspection records was developed. Inspectors worked in pairs and a report on every house and service made. Where leaks were discovered, a repair notice was left. Two weeks later a second inspection was made of all places where notice to repair was served. If repairs had not been made at that time a second repair notice was left and a re-inspection made three days later, at which time water was turned off, unless all plumbing was in good shape. The years of unlimited use and waste of water had rendered most people indifferent to the condition of the plumbing in their houses and at first considerable complaints were made at the so-called arbitrary ruling of the bureau. However, these soon ceased as the results of the survey became apparent and in the majority of cases splendid co-operation was secured.

The inspectors tested, first the house fixtures and then if these were O. K., tested with the aquaphone at the curb box for service leaks. If house waste was found, stop cock at the house was closed before testing for service leaks. On their inspection report blanks leaks were listed as service, faucet, toilet, etc., and a notice showing the nature of the leak served. A record of the number of people on each service was als reported. After the house inspection in a district was completed, the pitometer was again used to record the flow in different blocks in the sub-division. Where the night rate was still excessive, investigation for underground leaks was started. The determination of underground leaks is largely a matter of skill, judgment and experience. By sub-dividing by blocks the leak can be located as to block, but then the operator must find it by skill and judgment. If service pipes and boxes have been installed the aquaphone can give one the approximate location, and by driving a steel rod to the main the leak can be closely located. In only a few cases was it necessary to excavate more than one hole to find the leak.

*Seven Service Leaks at One Place.*

Probably the most difficult work in this line was on Northland Ave., in Section 3, where a night rate of 755,000 gals. was shown on one block. As there were practically no houses, and only one factory which was metered and did not account for but a fraction of the flow, all indications pointed to a large joint leak, or cracked pipe. In this street the pipe is laid in the sewer trench, which was excavated through rock. When the street was paved in 1893 house services had been placed every 60 ft. No large main leak was encountered, but seven service leaks were discovered and shut off at the main, which accounted for 700,000 gals. or practically the entire waste. The corporation cocks had in nearly every instance been destroyed and water was discharging directly into the sewer. No indications of these leaks appeared on the street surface.

*Permanent Map of Gauging Points and Valves*

As work was completed in each division a permanent map was filed in the office, showing gauging points for instrument and valves on boundary points. On this map is recorded date of first measurement, 24 hours consumption and minimum night rate, and same record of second measurement. It is the intent of the Bureau of Water to continue the pitometer work as a special department and regular measurements will be taken at varied intervals, and these maps will facilitate the work greatly. All inspectors' reports are filed by streets and can be instantly referred to. As soon as a section was completed a full report on it was submitted by the engineer-in-charge. This report gave a general summary of the work with certain specific recommendations to meet the conditions for the sections. These reports are filed so as to be available for future reference.

*Results in One Section*

The report for Section 4 showed as follows:

| | |
|---|---|
| Total flow before inspection per 24 hours | 17,936,000 Gals. |
| Minimum night rate | 14,912,000 Gals. |
| Per cent. of night rate to total flow | 86.2% |

Inspection of all buildings on this section showed: 3,444 leaky fixtures, divided as follows: faucets 1,064; toilets 2,380.

It also disclosed 280 leaky services, which were repaired by the owners; 8 unfinished supplies which were discharging into the sewer were dug up and plugged. Also, one broken 6-in. main was uncovered and repaired.

After the house inspection and underground work was completed a re-measurement was taken with the following results: Reduction in daily consumption 3,780,000 gals.; reduction in night rate 3,910,000 gals.

On acount of the desire to reduce the pumpage as quickly as possible, so as to conserve coal as a war measure, no intensive work was attempted and the city surveyed as rapidly as consistent with good work. It is highly probable that the results in this section could have been bettered had more time been devoted to it. However, by extending the work rapidly large leaks in other districts were detected and stopped in the time which might have been devoted to more intensive work in this section. It is expected that the work to be done in this section this summer will materially better the above result.

The efficiency of the survey as a means of reducing water consumption is shown by the records kept.

Before the survey there had been a gradually increasing yearly consumption, which in 1916-1917 showed a daily consumption of 168,000,000 gals. Had no effort been made to check this waste of water the present years would have called for a daily pumpage of 186,000,000 gals.

However, starting in July 1917, which was coincident with the start of the survey, each month showed a decrease in pumpage when compared with the same month in the preceding year except for the extremely cold months of December, 1917, and January and February 1918.

*Peculiar Local Conditions*

The records bring out very clearly two conditions more or less peculiar to Buffalo. Water consumption in the summer months is usually higher than the monthly mean, while the months of December, January and February are excessively greater. Buffalo's homes are usually set well back from the street and surrounded by a grass plot. This not only applies to the homes of the rich and well-to-do, but to the poorer classes as well. Practially 50% of our bills have a sprinkling

charge indicating that occupant uses a hose for sprinkling lawn or street. From 5:00 to 9:00 o'clock on summer nights we are likely to have close to our peak loads of the day at the stations and the water used for sprinkling is enormous in the aggregate.

Besides this use in the summer time we have an excessive waste in the winter from the anti-freezing closet. Most of these have been installed in the older sections of the city and the majority are in bad repair. Our records show close to ten thousand of them still in use. Besides these the plumbing installation in many of the cheap houses has been such that to keep pipes from freezing it is necessary to allow water to run. The effect of this is shown by consumption in winter months.

More careful inspection of new plumbing is now being made and the anti-freezing closet is being gradually eliminated. When these are all done away with a great source of waste is gone.

*Amount of Waste Curtailment*

Our first section was surveyed in 1917 and this year re-measurements have been taken. These show that there is a more or less gradual return of the waste first eliminated, depending wholly on the character of dwellings. In all sections the consumption was less than it was two years ago at the time of the first measurement. In one case the result showed only 20% increase over the first re-measurement. I estimate that effects of the result of the survey will be from one to three years as far as house waste is concerned. All underground leaks stopped are a permanent saving.

In the sections completed the house waste stopped is estimated at 18,000,000 gals., while the underground waste stopped was 12,000,000 gals. by actual measurements.

*City to be Surveyed Once in Two Years*

It is our intention to measure and sub-divide the entire city once in two years and completely to inspect as often. Of course measurements and inspections will be made oftener in the sections where waste is greatest. To control waste more fully in these sections meters will be placed gradually.

*Quick Results Obtained*

However, to reduce our pumpage quickly was imperative. I know of no other way which would have given results so quickly. To install meters would have taken from three to five years and the reduction would not have been felt for some time —at least not for the first six months when the size of the bill would have brought the waste of water home very forcefully to the householder.

In dividing the daily consumption the legitimate household use was assumed at 50 gals. per capita per day. The industrial use was assumed to be our total metered use, as practically all industries are metered. This use is practically 100 gals. per capita per day. It is hard to account for such a large industrial use of water per capita in a city the size of Buffalo. In my opinion it is directly due to the low meter rate of 2c per 1,000 gals. which for a long time was the charge here. This, in conjunction with a fairly high minimum charge for a meter, made the average metered service user indifferent to the amount of water used. The larger consumer, as a rule, found it cheaper to waste water than to investigate for leaks. Buffalo is also a large railroad center and the city supplies the railroads with water. In 1917 the meter rate was raised to 4c per 1,000 gals.

*Summary of Results Secured*

Nine tenths of the city has now been covered by the survey with the following results:

33,278 Leaky fixtures reported and repaired.
1,860 Leaky services reported and repaired.
52 Unfinished supplies found wasting 3,587,000 gals. per day. Broken mains and leaky joints wasting 4,376,000 gals. per day found and repaired.

The services, broken mains, unfinished supplies and leaky joints repaired account for 12,000,000 gals. waste per day permanently stopped.

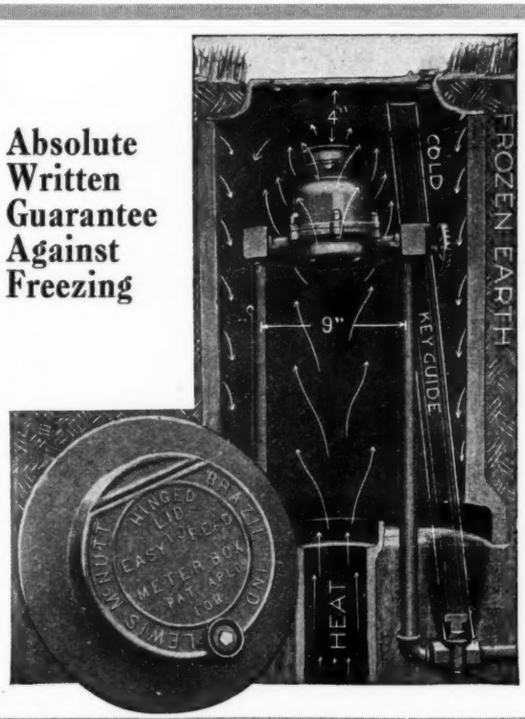
The pumpage has been reduced except in times of extremely hot or cold weather to less than 125,000,000 gals. per day, as compared to over 160,000,000 gals. per day in 1917.

*Cost Data*

Figuring the cost of pumping at $6.24 per 1,000,000 gals., the average cost for the last three years, the annual saving is $68,328. Against this is the estimated charge of $25,000 per year to maintain the Pitometer Division of the Bureau.

To date the survey has cost $96,931, much of which represents permanent investment in equipment and records, or for professional services.


**Absolute Written Guarantee Against Freezing**




# McNUTT *GUARANTEED* METER SETTINGS

**SAVE TIME, TROUBLE AND EXPENSE**

There is no guesswork or verbal promise about the freeze-proof features of **McNutt Meter Settings.** Thorough testing in actual service enables us to give an absolute *written* guarantee with every setting.

McNutt Meter Equipment prevents freezing, saves time and trouble in reading and setting, and eliminates 75 per cent of time in taking out and replacing meters. The McNutt Easy-to-Read 15-inch box, with hinged lid, guarantees protection and eliminates the old-style 18- and 20-inch boxes. The Easy-to-Install Yoke places risers 9-inch centers, pipes closest possible and farthest from frost line.

Write for complete information.
*Read our Absolute Guarantee.*

**McNutt Meter Box Co.**

**Box M 1.** **BRAZIL, IND.**

Including the pay of temporary inspectors, who will be employed each spring, it is estimated that the annual cost of continuing the work will be $25,000 per year.

From the survey made and results obtained it is evident that to a certain extent the house waste can be greatly reduced by house inspection controlled by pitometer measurements. When used in conjunction with selective metering the most flagrant house waste can be eliminated and the consumption reduced nearly to that obtained by universal metering and done at less expense. The pumpage can be reduced at least 20,000,000 gals. by the installation of 10,000 meters on house services where tremendous waste has been found by the survey. The installation of these meters is now proposed. A further reduction is not deemed advisable until a filtration plant is built.

*Cost Comparison of Universal Metering with Pitometer Control and Selective Metering*

A comparison between the cost of universal metering and the elimination and control of waste by the pitometer and selective metering is briefly as follows:

Control by pitometer and selective metering:

| | |
|---|---|
| Annual cost of inspection | $ 25,000 |
| Installation of 75,000 meters | |
| Investment in meters $100,000 | |
| Annual charge on meters, interest @ 4½% | 4,500 |
| Depreciation | 4,000 |
| Cost of reading and maintenance | 6,000 |
| Total annual cost | $ 39,500 |

Universal metering:

| | |
|---|---|
| Installation of 75,000 meters | |
| Investment in meters $750,000 | |
| Annual charges on meters, Int. @ 4½% | $ 33,750 |
| Depreciation 4% | 30,000 |
| Cost of reading and maintenance | 45,000 |
| Total cost | $108,750 |
| Annual saving in favor Pitometer control | 69,250 |

It is true that universal metering would reduce the consumption considerably more than the other method, but even if the reduction amounted to 20,000,000 gals. per day the saving in operation costs would not equal $69,250 per year.

The efficiency of any instrument is determined by how well it does what it is intended to do. If the object had been to reduce the consumption to a minimum the proper thing would have been to install meters and then eliminate underground waste by pitometer investigation. However, in any large water works there are certain features peculiar to it. For instance, the Buffalo Water Works had, at the time a reduction in pumpage was decided upon, two pumping stations, each capable of supplying 150,000,000 gals. of water a day with mains properly built for distributing this quantity. If the pumpage is reduced to 110,000,000 gals. of water a day for nine months of the year, one plant can be shut down for that period. After that saving is affected a further reduction in pumpage saves very little per 1,000,000 gals. pumped, as practically the same force is required to operate the plant whether 75,000,000 or 120,000,000 gals. are pumped, and irrespective of the pumpage, interest on the bonds accrues.

*Results Meet Expectations*

Our intention was to reduce by this survey our pumpage from 159,000,000 gals. to less than 115,000,000 gals. and before the work is completed this result will have been attained. Moreover, the data has been furnished so we know how to reduce the consumption further by intensive inspection and the installation of meters in certain districts.

*Acknowledgment*

The foregoing matter is a paper, slightly condensed, presented by Mr. Andrews at the recent annual convention of the American Water Works Association held in Buffalo, N. Y.

**Wm. Artingstall**

**Civil Engineer**

Old Colony Building Chicago

INVESTIGATION AND DESIGN OF WATER SUPPLY,
SEWAGE DISPOSAL AND MUNICIPAL IMPROVEMENTS.

## Laying Water Mains in Alleys.

*By C. R. Henderson, Manager Davenport Water Works Co., Davenport, Iowa.*

The plan of laying water mains, gas mains, sewers, steam mains, telephone conduits and all other underground structures, used for the service of the public, in the alleys instead of in the streets is frequently advocated and sometimes tried.

*Arguments in Favor of Mains in Alleys*

The principal reason given by advocates of the plan is that by laying mains in alleys the streets will be opened less frequently and consequently pavements will be less often disturbed. This is a very good reason, for we will all agree that it is seemingly impossible to replace pavements so as to avoid bumps and holes. It can be done by skillful and conscientious workmen, in the case of first class pavements, although the poorer the class of pavement the more difficult the job of replacement.

*Other Utility Lines in Alleys*

The laying of conduits in alleys for light, power, telephone and telegraph lines, is frequently adopted and seems to be practical in certain districts. Sanitary sewers might often be laid in alleys but where combination or storm water sewers are required the difficulty increases because catch basins must be provided at street intersections.

Of course it is true that nowadays alleys are paved as well as streets, and that there is as much difficulty about replacing the pavement in an alley as in a street, but alleys are not used for fast driving so much as are streets, and the scars made by excavation would not be so prominent in alleys as in streets.

*Objections to Use of Alleys for Water Mains*

The principal objection to the alley is that it is not wide enough to accommodate all the underground work and that alleys, as usually laid out, are not continuous and usually run in one direction only.

Gas mains and water mains, but especially water mains, must be laid as a gridiron, crossing frequently at right angles, and this is seldom possible if alleys are used exclusively.

Water mains supply fire hydrants which are necessary and are usually, and properly, located at street intersections. As an example: The commercial district of Davenport is covered by a perfect gridiron of good size mains. All the alleys in this district run east and west. If the mains were laid in these alleys the north and south mains would have to be laid in streets. In such case hydrants at street intersections would be on one main only while alley hydrants, which are less numerous, would be near intersecting mains.

Hydrants are also required halfway between street intersections on east and west streets as well as north and south streets and if mains were laid in alleys these hydrants would have to be eliminated as there would be no space in which to set them in our 20 ft. alleys.

A few years ago the writer tried to lay a small water main in an alley because it was desirable to avoid cutting a new pavement. There were several conduits in this alley used by telephone, telegraph and electric power companies and at the entrance of the alley were three manholes of considerable size. The water pipe could not be laid between the manholes because they overlapped. It could not be laid through them because the companies owning them objected, and it could not be laid under them because the ground was solid rock and blasting would disturb the conduit system. The new pavement was cut and the pipe was not laid in this alley.

Gas and water services require shut off cocks and curb boxes for outside control, and these are best located on sidewalks if they are to be accessible when needed.

Curb boxes should always be located on public property.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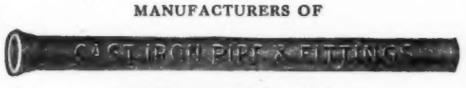


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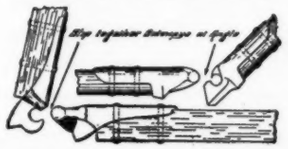

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When located in alleys heavy vehicles are likely to pass over them and break them. It is not desirable to place a curb box at any point where it may be covered by ash barrels, manure boxes or other material.

When locating a meter in a commercial district the front entrance to a building is superior to the rear entrance in most cases.

In existing residential districts the same objection above mentioned regarding the width of alleys and that they usually run in one direction only, and not continuously, applies. In new additions provisions could be made so long as one policy prevailed, but then mains running at right angles to the prevailing direction of the alleys would have to be laid in streets.

When blocks are 500 to 800 ft. between cross streets, sufficient hydrants would not be possible for proper protection, conveniently located, when mains were in alleys.

*Alley Location of Water Mains Proved Impractical at Davenport*

In two cases the plan of laying water mains in alleys has been tried in new additions in Davenport. In one case, a high class residence district, private rights of way had to be provided for hydrant branches, also for some mains, in order to complete the lay out. One 8 in. main in this district now lies very deep under a brick wall and other expensive improvements in the yards of fine houses. The alley was vacated in this case. Parts of the district were platted without alleys and mains were laid in the streets, necessarily.

In another district, houses were built facing, and on each side of a wide boulevard. The water mains were laid in the alleys behind each row of houses. This plan worked all right until houses were built on the far side of one of the next parallel streets when mains had to be provided for them. There being no alley, the main was laid in the street, and we now have parallel mains one half block apart.

In one Iowa City the principal main was laid through the alleys of the commercial district. Fire hydrants located at t. street intersections were supplied from this main by long branches of smaller pipe. These long hydrant branches added to the expense of the system, added to the loss of head between the main and the hydrant, and there being no flow in the pipe between the main and hydrant, the danger of freezing would naturally be greater than in a normal installation.

The writer is willing to concede that the alleys could be utilized for some utilities—probably wiring and sanitary sewers—but contends that water mains for reasons applying to safety and economy had best be laid in the streets.

The foregoing paper was presented at the recent annual meeting of the Iowa section of the American Water Works Association.

## Loosening Hard Soil in Water Pipe Line Trench Without Picking

*By Charles F. Higgs.*

We were digging a ditch four miles long in which to lay a water supply pipe line from the source of supply to a town which was to have water service. We encountered rock and many types of soil along the right of way and were using dynamite to dispose of the rock. The soil in many places was so hard that much laborious picking was necessary to loosen it and the time consumed in doing this was greatly delaying the completion of the work.

*Blasting Suggested*

It was suggested that dynamite could be used also to loosen this hard soil thus reducing, and in some cases, altogether obviating the pick. The foreman of the job, however, had never heard of using dynamite for hard soil and expressed the opinion that the blasting would throw the dirt so far away

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from the ditch that it would not be available for filling in over the pipe.

I expressed the opinion that this could be avoided by using charges only large enough to loosen the soil but not large enough to throw it out as would be done if a ditch were being blasted. It was decided to try this experiment.

*Blasting Proves Successful.*

The tools required were 10 lb. sledge hammers and a steel drive point 1½ ins. in diameter. The sledges were used to drive the steel bar into the ground making the holes 2 ft. deep in which the charges of dynamite were loaded.

The holes were spaced 4 ft. apart, each hole being loaded with ¼ lb. of 40% dynamite well tamped in. As we had no blasting machine, a blasting cap and length of fuse was inserted in each charge. The charge being small, a man could go along the line of charges lighting the fuses without risking any danger from the blasts going off 40 or 50 ft. behind him.

The experiment was an entire success and the method was adopted for digging the three miles of ditch uncompleted at the time the experiment was made.

These small blasts loosened the hard ground very nicely. It was possible to shovel out most of the dirt without any picking whatever.

Because of the time of labor saved by the blasting, the cost of the work was greatly reduced and the time of completion of the job decidedly shortened.

## Advantages of State Supervision of Water Works

*By Frederic Bass, Professor of Civil Engineering, University of Minnesota, Minneapolis, Minn.*

The English Reform Bill of 1832 brought municipal government into question. An investigation followed which revealed a situation corrupt far beyond that ever witnessed in any American city and resulted in legislation which finally placed many supervisory powers in the hands of the central or national government. Among the agencies now exercising these central powers is the Local Government Board which has the power to issue regulations having the force of law governing many municipal activities, including relief of the poor, public health and sanitation, fixing of boundaries, municipal borrowing and others. The purpose of this Board is to harmonize and promote the correct functioning of many municipal activities. It does not initiate or expand or directly supervise projects, but supplies expert studies and investigations such as the State Boards of Health in America do in regard to public water supplies, sewerage and public works of a sanitary nature, or as State Public Utility Commissions do in regard to certain public utilities.

There are many municipal problems of construction which may or may not involve sanitary questions which are of vital

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interest not only to the municipalities immediately concerned but also to their commercially tributary area, and in some cases to the entire state in which they are situated. Among these are the standards of service which public water supplies shall meet.

A State Board of Health may compel a municipality to cut off a cross-connection to an auxiliary polluted water supply which is used only in emergencies at times of fire. It is quite correct for it to do so. But there is no authority nor any official state board to compel or advise a city to provide for means of fire protection by storage, increased pumping capacity or otherwise, and while the city has gained protection against disease it may have lost it against fire. It may be said that a communicable disease will not stop at city limits and therefore control of sanitary conditions is required, it is also true that a disastrous fire in any city is a damage to its whole tributary trade area; the principle of state interest in the standards of protection is the same in both cases.

*The Fire Hazard*

Fire insurance companies have combined to standardize public waterworks so far as fire protection equipment is concerned in order that their insurance rates might be equalized. But the fire hazard is not impressed upon the city authorities as is the disease hazard, with the result that we see the great majority of small cities and villages without adequate fire protection, protection which would be warranted from an economic standpoint. The cure for this condition would be an efficient scientific supervision of water supplies by a state body which would concern itself not only with the sanitary features of design and operation but also those which are of a structural and economic nature, thus dealing with the entire unit. Such a board could do all that the State Board of Health could do and much more to the benefit of the local community. Since the province of public health has been within recent years sharply specialized, and many expert sanitary engineers are available whose judgment on sanitary, economic and structural features of water works is of the highest character, it would seem that state supervision of public water supplies might better be vested in a board similar to that of the Local Government Board of England, which might review public works in their entirety.

To reinforce this suggestion it might be stated that such a board would find a large usefulness to the cities in giving general advice in regard to other public improvements such as public buildings, pavements and city planning. Probably advice in regard to municipal finance would be one of the most valuable functions of a State Board of Public Works, but the point here emphasized is that public water supplies should be standardized on the basis of fire protection by a public agency.


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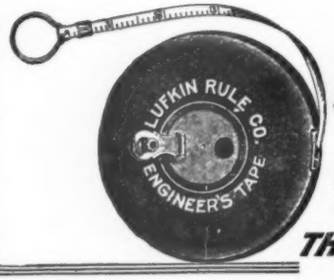


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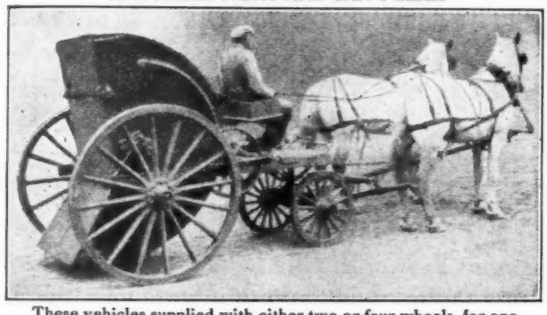

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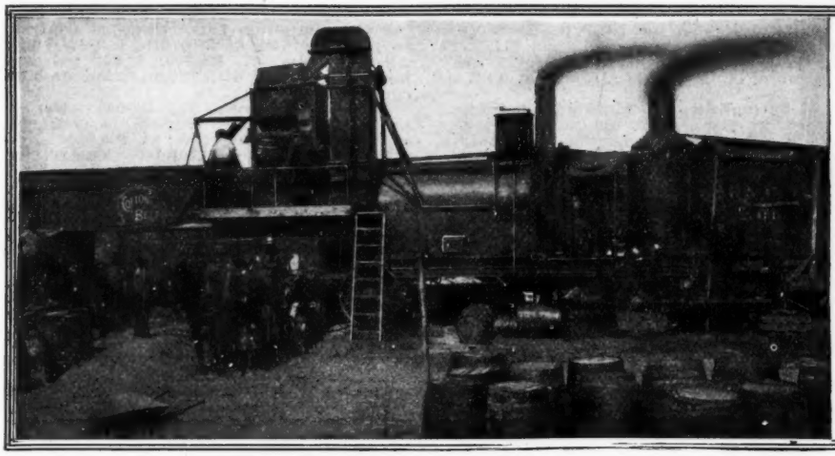

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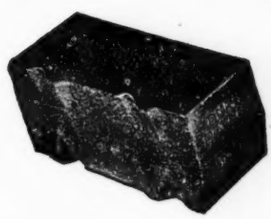

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**Ala., Sheffield**—Crinkley Construction Co. Harriman, Tenn., awarded contract for paving at $300,000; bitulithic on macadam base.

**Ark., Little Rock** — Phoenix Company, Fort Smith, awarded contract for road improvement District No. 5, at $61,000. Road will be 9½ miles long.

**Ark., Ashdown**—Phoenix Company, Fort Smith, Ark., awarded contract by Little River County Commrs., to construct 9½ miles of road from Foreman to Laynesport, at $61,000.

**Ark., Harrisburg**—P. G. Smith & Co., city, awarded contract for constructing road over Nickel Plate route from this city to Jackson County line, at $135,000.

**Ark., Jonesboro**—J. E. Edwards Construction Co., Little Rock, Ark., awarded contracts for constructing roads in Lake City-Nettleton & Bay Road Impvt., District No. 1, Craighead County, at $430,830.

**Ark, Pine Bluff**—Parkes Engineering Co., city, awarded contract to do the engineering work for road impvt. district No. 5, Conway county, which is to construct a road running east and north of Plumerville at probable cost of $250,000.

**Cal., Los Angeles**—Geo. H. Oswald, O. T. Johnson Bldg., awarded contract by Board of Public Works, for improvement of Huntington Drive and other streets in Rose Hill and Pyrites St. Impvt. Dist., at $115,826.

**Del., Wilmington** — Richard Hopkins, Troy, N. Y., awarded contract for construction of 24-ft. concrete rdway. that is to transform the Kennett turnpike into a free public road (cost to be borne by Pierre S. Du Pont); 5 miles concrete, at $435,000, or approx. $87,000 per mile. Contract will be let to Du Pont Engrg. Co., who will sublet actual constr. work to Mr. Hopkins. This contractor now building part of Philadelphia turnpike.

**Fla., Kissimmee**—Malony & Murphy, Chattanooga, Tenn., awarded contract by State Road Dept., to build 2¾ miles of road from here to Campbell Sta., completing hard-surf. road from Tampa to Jacksonville; rd. and brdgs. to cost $60,000.

**Ga., Buchanon**—Stanley & Springer, Breman, Ga., awarded contract to construct roads in Haralson county; $400,000 available.

**Ida., Twin Falls**—C. H. Helmer, city, awarded contract for paving certain streets here, having concrete base with bitulithic top, at approx. $84,915.

**Ill., Chicago**—Blase & Gerken Construction Co. awarded contract by County Board for construction of 10,240 ft., section 40, at $47,949; also for 2,687 ft., sect. 48, Irving Park boulevard road, at $11,722; Eclipse Construction Co., contr. for 28,106 ft., section 41, Milwaukee Road, at $131,442.

**Ill., Springfield** — Following contracts awarded by Department of Public Works (Bureau of Roads): Lincoln Highway, south of Lombard, south of W. Chicago, 8.43 miles, to Calumet Construction Co., at $158,000; West Chicago to St. Charles; 4.93 miles, to Illinois Hydraulic Stone and Construction Company, at $103,300; St. Charles School for Boys to Dekalb, 18.48 miles, to J. O. Heyworth, at $363,227; Dixie Highway —3 miles south of Grant Park, 1.1 miles, to Cameron and Joyce, at $21,632; south of Grant Park to Will-Kankakee county lines, 6.6 miles, to Embankment Co., at $144,109.

**Ill., Winnetka**—Marquette Constr. Co., Chicago, awarded contr. for paving at $228,957.

**Ind., Columbus** — Premier Construction Co., Indianapolis, awarded contract for construction of Nentrup road within corp. limits of city, at $67,850.

**Ind., Crown Point**—United Construction Co., Hammond, awarded contract by the County Commrs., for J. C. Becker road (Columbia Ave., Hammond), at $167,980.

**Ind., Frankfort**—A. F. Cohee, awarded contract for E. C. Fisher et al brick road at $79,000.

**Ind., Indianapolis**—Hoss & Pothast Construction Co., city, awarded contract by Commrs. Marion Co., for 3 miles concrete pavement on Allisonville Road, at $97,000; S. M. Timberlake Const. Co., city, awarded contract for 2 miles conc. on Orchard Ave. road, at $70,400.

**Ind., Terre Haute**—Following contracts awarded by Vigo County Commrs.: Carpenter Constr. Co., contract for constructing Jno. L. Crawford-Maple Ave., Rd., at $58,476.

**Ind., Terre Haute**—Premier Construction Co., awarded contr. for the Jno. L. Smith Rd., on N. 25th street, at $82,500.

**Ind., Terre Haute**—Pfizenmayer Constr. Co., Terre Haute, awarded contract for grading and paving ½ mile Poplar street, 36 ft. wide, involving 11,420 sq. yds. 8-in. conc., at $31,250; grading, paving, guttering and curbing, ½ mile So. 11th street, 33 ft. wide, involving 10,170 sq. yds. 8-in. conc. at $26,559; ½ mile. Garfield Ave., 26 ft. wide, involving 8,170 sq. yds. 8-in. concrete, at $22,750.

**Iowa, Fairfield**— Cameron and Joyce, Keokuk, awarded contracts by Board of Supvrs., for bridge and road work, at $110,000.

**Iowa, Logan**—E. A. Wickham Co., Council Bluffs, awarded contract for bldg. 60,000 sq. yds. conc. or monolithic brick pavement; 40,000 lin. ft. conc. curb and gutter and storm sewerage system, at $211,185.

**Iowa, Mapleton**— National Roofing Co., Omaha, awarded contract for sheet asph. paving on 72 blocks of streets, at $3.11 per sq. yd. Total est. cost, $300,000.

**Ky., Owensboro**—Andrews Asphalt Paving Co., Hamilton Ohio, awarded contract to pave sections of 5th, 4th, 6th, 2nd and Allen streets, at $55,000; 34,000 sq. yds. macadam streets with bitum.-conc. or bitu. construction.

**La., Columbia**—C. A. Reese, awarded contract by Caldwell Parish, to construct 15 miles of gravel road, at $65,000.

**Md., Baltimore** — Arundel Construction Co., Pier 2, Pratt St., awarded contract by city for alley paving at $50,000.

**Md., Chestertown**—Kaufman & Co., Federalsburg, Md., awarded contract by State Roads Comn., Baltimore, for Rock Hall-Swan Creek road construction, 3.03 miles long by 14 ft. wide, at $76,220.

**Md., Ellicott City**—Claiborne, Johnston & Co., Garrett Bldg., Baltimore, awarded contract for Clarkeville pike constr.; 2.51 miles long by 20 ft. wide, at $89,873.

**Md., Frederick**—Fisher & Carozza, Calvert Bldg., Baltimore, awarded contract for Knoxville to Harper's Ferry road construction; 3.51 miles long, by 20 ft. wide, at $89,895.

**Md., Frederick**—Potomac Engineering & Constr. Co., Law Bldg., Baltimore, awarded contract for bldg. 1.8 miles State Aid hwy., Emmettsburg to Bridgeport, 15 ft. wide, 8-in. conc. in center, 6-in. on sides, 3 ft. dirt shoulders, etc., at $65,098.

**Md., Westminster**—Thomas, Bennett & Hunter, Westminster, awarded contract by State Roads Comn., Garrett Bldg., Baltimore, for Littletown Pike construction; 2.01 miles long by 20 ft. wide, at $53,644.

**Mass., Boston**—James H. Fannon, Somerville, awarded contract for constr. of 25,400 ft. of highway in Acton, Concord and Littleton, at $131,853.

**Mich., Hart**—Irwin Sutzer, Oceana Drain Commr., awarded contract to grade and put in culverts on 10 miles of road from Montague to New Era, at $21,000.

**Mich., Lansing**—R. D. Baker & Co., Detroit, awarded contract for 4,335 miles concrete road near Farmington, Oakland County, at $175,710; 3.567 miles gravel road in Woodbridge and Camden Twps., to Bishop and Rowlson, Hillsdale, at $37,797; 10.072 miles gravel road in Saginaw, to W. L. S. Hinkley, Flushing, at $102,195; 11.695 miles gravel road near Saginaw to Midland Construction Co., Midland, at $174,905.

**Mich., Mt. Clemens**—James McKay, Detroit, awarded contract by Macomb Co. Road Commrs., for constr. of 4.87 miles of 16-ft. concrete paving to connect Utica and Mt. Clemens, at $120,000.

**Mich., Jackson**—Wm. H. Ryan, Lansing, awarded contract by City Comn., for paving with brick, Page Ave. and Pearl St., at $97,000.

**Miss., Greenwood**—W. F. Kelly, awarded contract for Shellmound Road, to Sunflower Co., line by way of Schlater—(13.85 mi. long, 16 ft. wide and 6 ins. deep), to be graveled, at $50,000.

**Minn., Anoka**—W. S. Harris, 2449 Pillsbury Ave., Minneapolis, awarded contract for paving 23 blocks, at $105,314.


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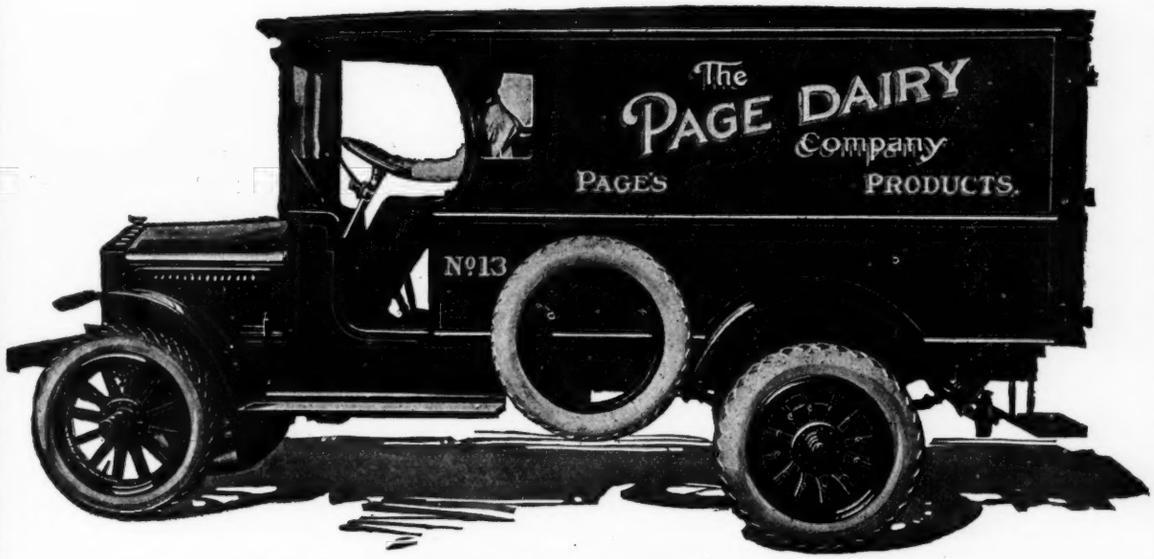


**The Garford Motor Truck Company, Lima, Ohio**

Motor Trucks of All Capacities

*Distributors and Service Stations in all Principal Cities*

**Minn., Fergus Falls**—Winston Bros., Minneapolis, awarded contract by Otter-tail County Commrs., for constr. of Fed. hwy., from this city to county line near Ashoy, at $102,355.

**Minn., Minneapolis**—General Contracting Co., awarded contract for continuous strip of bitu. pavement from Robbinsdale to Champlin at $196,000.

**Neb., Madison** — Edward Peterson Co., Omaha, awarded contract for the dirt work at 34c per sq. yd. for Platte Co., and 37c per sq. yd. for Madison county. Approx. cost of both contracts, $90,000.

**N. J., Trenton**—J. M. Kelly Construction Co., 432 Market street, Camden, awarded contract by State Hwy. Comn., for paving with concrete 5.15 miles, State Hwy. No. 6, Mullica Hill-Mantua Sec., Gloucester Co., at $180,330.

**N. M., Albuquerque** — Springer Transfer Co., Albuquerque, N. M., awarded contract for constructing the Tjeras Canyon National Forest Road Project, in Manzano National Forest, Bermanillo county—4.57 miles long, at $17,376; W. E. Ralls & Chas. A. Cunningham, Alamogordo, N. M., awarded contract for constructing Highrolls-Weed, Sect. A. & B. Proj., in Lincoln National Forest, Otero Co., N. M.—7.52 miles long, at $38,635; Littlejohn, Singleton and Murphy, Nogales, Ariz., awarded contract for constructing Apache Camp Soldier Camp Project in Coronado National Forest, Pima Co.—7.23 miles long, at $50,-977.

**N. Y., Albany**—Cleveland & Sons Co., Brockport, N. Y., awarded contract for constructing hwys. from west line of Huron—about 3.83 miles—at $119,018; also No. 2—from that point of Wolcott—abt. 3.21 miles—at $87,527.

**N. Y., Binghamton**—T. H. Gill Contracting Co., Binghamton, awarded contract for construction of primary hwys., in townships of Monroe and Towanda, Bradford county, Pennsylvania. Contracts call for constr. of 16,362 ft. bitum. surf. over conc. fdn. Initial estimates for work total $146,-440.

**N. D., Grafton**—John O'Connor Co., Fargo, N. D., awarded contract for furnishing material and constructing approx. 19,500 sq. yds. paving, resetting existing stone curbs, constructing necessary circular concrete curbing, catch-basins and inlet pipes, etc., at $72,424.

**N. D., La Moure**—A. J. Jackson, Jamestown, N. D., awarded contract by La Moure Co., for grading, surfacing with gravel and installing monolithic concrete culverts on 4.7 miles of road east and west through La Moure, at $25,585.

**Ohio, Canton**—Urban Bros., awarded contract by Commrs., for paving the Wilmot-North Lawrence road, at $61,872. Paving will consist of concrete base and curbs, with tar filler; Burd Construction Co., awarded contract to build Georgetown road, using slag base, conc. curbs and a mixed tar and sand filler, at $41,311; Brewster-Massillon Highway, awarded to the Highway Construction Co., Elyria, at $37,-930.

**Ohio, Cleveland** -Cleveland-Trinidad Paving Co., awarded contract for paving extension of Carnegie Ave., SR-E, 89th to E. 100th street, at $66,786.

**Ohio, Columbus**—Freshwater & Sons, Zanesville, awarded contract for grading, bldg. bridges and culverts; also paving with monolithic brick, 7.71 miles Sec. J. and 5.43 miles Sect. Q, Cleveland-Buffalo road, Lake county, at $275,822 and $195,-363, respectively; S. W. Wrightser & Sons, Logan, awarded contract for 9,550 ft. Sect. F., Steubenville-Cambridge Rd. waterbound macadam, at $30,690.

**Ohio, Coshocton** — Henderson Bros., awarded contract for improving the Newark - Coshocton inter-county highway — Randles bridge south of here, to Tyndall; 2.48 miles, at $91,821; Jno. Hall awarded contract for monolithic brick pavement, at $100,795.

**Ohio, Jefferson**—E. A. Freshwater and Sons, awarded contract for paving Market road—North Ridge road betw. Plainsville and Geneva—at $475,000.

**Ohio, Marion**— Brady & O'Connell, Marion, awarded contract for Marion-Kenton road (water-bound macadam) at $134,767.

**Ohio, Perrysburg**—Federal Asphalt Paving Co., 316 Rentschler bldg., Hamilton, awarded contract for paving 5th street (Trinidad Lake asph.) 2 in. thick on 6-in. conc. base and concrete curbing, at $56,977.

**Ohio, Toledo**—Harrison & Tansey, Toledo, awarded contract for 3 miles paving on nine streets on West Moreland Addn., at $33,000.

**Okla., Tulsa**—Big Four Constr. Co., Springfield, Mo., awarded contract by Tulsa Co. Commrs., to construct five sections of road betw. Tulsa and Jenks, at $232,983.

**Okla., Tulsa**—Tulsa County Commrs. awarded following contracts, totaling over $1,000,000, to hard-surface 40.15 miles of road; J. T. Lantry at $402,726, 12-mile one-course conc. rdway, 18 ft. wide, from Tulsa to Skiatook; J. T. Lantry at $213,758, Tulsa-Bixby Rd., Sects. N & Q, one-course conc., 18 ft. wide; Matthews, Standevent & Vanderslice Constr. Co., at $235,466, Sects. K & L, Tulsa-Bixby Rd. Standard Pavg. Co., at $248,970, Sects S & R, Tulsa to Jenks, 9 miles, one-course conc. rdway, 18 ft. wide.

**Ore., Astoria**—Miller & Bauer, awarded contract for constr. of Astoria street—10th to 2nd streets—at $125,980.

**Ore., Portland** — Following contracts awarded by State Hwy. Comn., totaling $2,719,673. These include 11 contracts for hard-surf. pavement of total length of 106.9 miles at cost of $2,454,777; 4 contracts for grading rdways, 38.65 miles, cost, $221,-146; removal of a slide for $19,950 and constr. of John Day brdg., at $24,500. On Myrtle Creek to Dillard section of Pacific Hwy., 12.8 miles long, Oregon Hassam Paving Co., lowered its bid by $6,160 and was awarded contract at $316,906; Oregon Independent Paving Co., reduced its bid for surfacing Amity-Holmes gap section of hwy., $8,860, and was awarded contract at $245,170 (this sec. 8.3 miles); Oakland to Yoncalla section, 10.4 miles long, awarded to Clark & Henry Constr. Co., at $272,-321, after making reduction from original bid of $19,880.

**Pa., Ebensburg**—Vipond Constr. Co., 2222 Beale Ave., Altoona, awarded contract by Cambria Co., for paving 5 miles Yoder Twp. Rd., 16-21 ft. wide, brick, at about $350,000.

**Pa., Greensburg**—Luther F. Edwards & Bros., local awarded contract for resurfacing county highway betw. Donora and Monongahela, at $65,000.

**Pa., Harrisburg**— Quinlan & Robertson, Inc., New York, awarded contract by State Hwy. Dept., for approx. 8 miles of rdway on route connecting Reading & Pottsville, at $398,136. Constr. calls for 40,004 ft. reinforced conc. and hillside vitr. brk.

**Pa., Johnstown**— R. R. Myers, Loretta-Cresson Road, brick on concrete, at $164,-000.

**Pa., Moscow**—Harvey B. Sproul Construction Co., Peekskill, N. Y., awarded contract for 8,915 ft. bitum. surf. course on conc. fdn., and Hillside vitr. brk., in Moscow Boro, Lackawanna Co., at $72,230; contract for 29,546 ft. bitum. surf. course on conc. fdn., in Pike Co., Milford and Westfall Twps., at $199,826.

**Pa., New Kensington**—State Construction Co., foot 5th street, awarded contract for grading, paving and curbing Catalpa street—Stanton to Ridge Aves., North St. —Taylor to Freeport Rd., and from Stanton Ave., to Taylor Rd.; also Ridge Ave., from end of present paving to Catalpa St., at abt. $55,000.

**Pa., Pittsburgh**—A. Ancarani, Portvue, awarded contract by Allegheny County Controller, J. P. Moore, for bldg. 10,500 ft. New England Rd., Mifflin Twp., 16 ft. wide, Telford macadam with waterbound macadam wearing surface, at about $105,-030.

**S. D., Aberdeen**—G. W. Humphrey, Pingree, N. D., awarded contract by Brown Co., for grading, surfacing with gravel and installing monolithic concrete and corr. metal culverts on 12.8 miles of road east and west through Groton, at $64,159.

**S. D., Clark**—Roach Bros., Clark, S. D., awarded contract by Clark Co., for grading, surfacing with gravel and installing monolithic conc. culverts, on 16.5 miles of road east and west through Clark, at $74,671.

**Tenn., Johnston City**—R. L. Peters, Knoxville, Tenn., awarded contr. for constr. of 12.5 mi. macad. rd., 14 ft. surf. macad. compacted to 6½ ins. 24 ft. rdway; 17 mi. 10-ft. macad. surf. (6½ ins. thick) 18 ft. rdway; 15 to 18 small reinf. conc. bridges, at $268,000.

**Tenn., Tazewell**—Soloman Constr. Co., Harriman, Tenn., awarded contract by Claiborne Co., to macadamize roads; $200,-000 available.

**Tex., Dallas**—Texas Bitulithic Co., Dallas, awarded contract to pave sections of Throckmorten, Reagan and Knight streets, at $62,609.

**Tex., Dallas**—Healy Construction Co., Fort Worth, awarded contract to construct Dallas-Fort Worth road between Dallas and Tarrant county line, at $304,-711.

**Tex., Snyder**—Sanders Bros., Miami, awarded contract by Scurry County Comrs. to construct 20 miles gravel and earth hwy. $73,500 available.

**Va., Norfolk**—T. J. McGuire, Norfolk, awarded contract to pave Boush street—Dartmouth to Brooke Ave.—with durax; also curb and gutter various streets in Huntersville, at $32,369 and $15,416, respectively.

**Wash., Bellingham** — Everson-Nooksack road contract awarded to Riddle and Hawkins, at $96,364.

**Wash., Seattle**— Philbrick & Stratton, Raymond, awarded contracts for wk. on National Park Hwy., by Pacific County Board of Commrs. Total cost of work, $84,906; K. L. Goulter, awarded contract for surfacing 5 miles of hwy., with crushed rock from Bear River bridge west, at $38,990.

**Wash., Seattle**—King County Comn., awarded following road bldg. contract: Seattle-Renton paving, 1.303 miles in length, to Seaboard Constr. Co., at $34,-725; Houghton-Medina-Bellevue paving, 1.-202 miles, to J. L. Smith, at $20,450, and Auburn-Enumclaw Paving, 1.988 mi., to L. M. Morgan, Everett, at $59,857.

**Wash., Seattle**—Puget Sound Engrg. Co., 611 Mutual Life Bldg., awarded contract for street paving in Kent Washington (conc.) at $99,930.

**Wash., Spokane** — DeCamp Bros. & Hughes, local, awarded contract for grading, curbing, sidewalking and bldg. retaining wall of Trent Ave., impvt. betw. Trent bridges, at $23,550.

**W. Va., Clarksburg**— Ferguson & Holbert, awarded contract for improving Fairmont and Clarksburg pike—Gore to Hepzibah—at $94,594; Salem Constr. Co., awarded contract for impvts. on Wolf Summit Rd., at $76,906; Allen & Horner, awarded contract for improving Mount Clare rd., at $56,649; Anthony Fiori, awarded contr. for Johnson Ford road, at $56,065.

**Wis., Eau Claire**—A. Larson & Co., awarded contract for concrete hwy. work on Eau Claire-Chippewa Falls hwy at approx. $209,000. Highway will be 18 ft. wide; concrete 6-ins. thick on sides with an 8-in. thickness on crown or middle of road.

**Wis., Fond du Lac**—Garvey & Weyenburg Constr. Co., Appleton, awarded contract for Fond du Lac-Oshkosh Road, at $106,871.

**Wis., Milwaukee** — Milwaukee General Constr. Co., 857 8th Ave., Milwaukee, awarded general contract by Milwaukee Co., for Wood Lawn Ave., No. 1, state road work, grading, etc., at $55,150.

**Wis., Sheboygan**—Deon Construction Co., Milwaukee, awarded contract for Sheboygan-Plymouth road, Project No. 69; grading, culverting and surfacing with concrete, at $70,854.

**Wis., Waupun**—Harry Gerrity & Son, Beloit, awarded contract for construction of state hwy., betw. Mayville and Horicon, at $50,000.

## SEWERAGE AND SEWAGE TREATMENT.

**Ark., Nashville**—McEachim & McEachim, Little Rock, awarded contract to construct sewers and water works.

**Cal., Fresno** — Thompson Bros. Co., awarded contract for constructing 6-in. sanitary sewers in Arlington Heights' tract at 88c lin. ft., for sewers and $55 each for manholes.

**Cal., Los Angeles**—N. R. Bridges, awarded contract for constr. of cement-pipe sanitary sewer in 61st street, betw. Figueroa street and Moneta Ave., at $1,239.

**Cal., Los Angeles**— M. S. Cummings, awarded contract for construction of a clay pipe sanitary sewer in Savannah street—New Jersey street to Brooklyn avenue; Mike Chutuk, awarded contract for construction of a cement pipe sanitary sewer in 60th street—Figueroa street to Moneta avenue, at $1,709; Biaz D. Zaich, awarded contract for constructing cement pipe sanitary sewer in Long Beach avenue betw. 55th street and 134 ft. north of 31st street, at $15,885.

**Cal., Seal Beach**—Mlagenovich & Gillespie, Los Angeles, awarded contract for constr. of city sewer system; $40,000 bonds voted for sewer have been sold.

**Cal., Stockton**—T. E. Clinch, awarded contract for laying the West Street sewer at $2,122.

**Conn., Bridgeport** — Following contracts let by city: 1,500 ft. san. & storm sewers in Spring street, to L. Jacques Constr. Co., 608 Montgomery Ave., Elizabeth, N. J., at $24,868; 5,760 lin. ft., in Canfield Ave., to L. Patrossi, 39 Woodbridge Ave., Hartford, at $6,356; Pierce Mfg. Co., 785 Housatonic Ave., at $14,142, and L. Jacques Constr. Co., 608 Montgomery Ave., Elizabeth, N. J., at $23,549.

**Conn., New Haven**—Dwyer & Mannix, 333 Shelton Ave., awarded contract by city for bldg. vitr. storm water and overflow sewer and appurts. in Munson St. &

Beaver Park lands betw. Canal and Crescent streets, at $55,125.

**Fla., Winter Park**—Southern Clay Mfg. Co., Chattanooga, Tenn., awarded contract to construct 19,000 sq. yds. paving and 19,000 ft. curbing at $60,000.

**Ill., Carlinville**—Spence & Sons, Springfield, awarded contract for construction of sewer for sanitary district No. 1, at $31,795.

**Ill., Chicago**—F. E. Newberry Electric Co., of Illinois, awarded contr. for bldg. an underground conduit system from 56th street and Western Ave., south. to 103rd street, at $45,701.

**Ind., Indianapolis**—Jno. H. King, Indianapolis, awarded contract by State Bd. of Agriculture, for constructing new sewage system in Fair Grounds, at $7,990.

**Ind., Indianapolis**—Columbia Construction Co., awarded contract for constructing sewer in 27th and Burton Ave., betw. Harding and Roach Sts., at $3.36 lin ft., and for constructing sewer in Darnell street from Brooks to point 585 ft. east of center of Brooks street, at $3.20 lin. ft.

**Iowa, Alta**—E. M. Scheflour, Elgin, Ill., awarded contract for constructing sewage disp. plant, main and lateral sewers here at $54,771.

**Iowa, Cedar Rapids**—R. C. De La Hunt, 923 18th Ave., W., awarded contract for sanitary sewer along 29th street to C avenue and in C avenue from 29th to 32nd street, at $3,992.

**Iowa, Cedar Rapids**—Verney & Kloet, awarded contract for constructing sewer in Horton avenue, Burton street to 300 ft. south of Melville street, at $3,340.

**Iowa, Davenport**—M. McElligott, Evanston, Ill., awarded contract for sewerage system at Williamsburg, Ia., $37,000; Ward & Leighton, Sioux City, contract for the disposal plant, at $12,500.

**Iowa, Logan**—E. A. Wickham Co., Council Bluffs, awarded contract for bldg. storm sewerage system; also 60,000 sq. yds. conc. or monolithic brk. pavement, 40,000 lin. ft. conc. curb. & gutter, at a total cost of $211,188.

**Ind., South Bend**—H. L. Webster awarded contract for pipe sewers on Jackson, Fisher and Fellows streets.

**Kans., Cottonwood Falls**—McCoy & Raylor, Emporia, awarded contract for constructing sewer system here at approx. $64,000.

**Md., Baltimore**—A. F. Fedeli, 403 Vickers Bldg., awarded contract by Morgan Pk. Co., for constructing sewers, at $8,000.

**Mass., Boston**—W. Barrett, 27 Hunneman street, Dorchester, awarded contract by city for bldg. rein. conc. sewer in Blackstone St., involving 1,175 ft. 4 ft. x 4-6 in. rein. conc. pipe, 2,000 cu. yds., earth trenching, 20 tons reinforcing steel, at $43-890, in Tremont street, involving 125 ft. 12 and 18 in. vitr. pipe, 200 cu. yds. earth trenching, to C. Grande, 50 Hull St., at $8,224.

**Mich., Detroit**—Walbridge, Aldinger Co., award contr. for constructing sewer in Lonyo Rd.—Baby Crk. to Kirkwood Ave.—at $1,430,000; J. Connelly Constr. Co., awarded contr. for sewer one mile long, at $276,300.

**Mo., Rock Port**—Katz Construction Co., Omaha, awarded contract for furnishing all labor and material for constructing approx. 3 miles of 6-in. and 8-in., also 10-in. vitr. pipe sewer here at $19,000.

**Neb., Geneva**—S. A. Canaglia & Co., Omaha, awarded contract for city sewerage system at $30,224.

**Neb., Omaha**—Hanson & Willadsen Co., 2907 Douglas street, awarded contract for bldg. storm sewer in 31st and Farnam streets along Turner Blvd., S. W. to 34th and Jones streets, involving 2,140 ft., 45-54 in. segmental block and 435 ft., 18-in. vitr. pipe, at $25,778: 1,153 ft. 48-in. reinforced conc. storm sewer—13th to Emmet street along railway right-of-way to E. P. Donahue, 306 Lincoln Blvd., at $22,543.

**N. J., Huntley**—Salvatore Guardalibeu, Lodi, N. J., awarded contract for furnishing material and constructing vitr. pipe sanitary sewer on Center street, involving 2,572 ft. trench various depths, 3,200 ft. 5-in. vitr. pipe, 5,000 ft. 6-in. vitr. pipe and 22 manholes, at $15,279.

**N. J., Newark**—No. Atlantic Constr. Co., 207 Market St., awarded contract by Passaic Valley Sewerage Comn., for bldg. Sect. 30, Newark Branch Sewer, at $251,-865.

**N. J., Passaic**—Union Bldg. & Constr. Co., awarded contract for laying sanitary sewer in Spring St.

**N. Y., Brooklyn**—L. Kalisher, 1225 Myrtle Ave., awarded contract for bldg. sewers in Remsen and Utica Aves., at $239,088.

**N. C., Durham**—Quinn Company awarded contract for sewer work on city's main street, incident to laying of perm. pavement.

**N. C., Winston-Salem**—Crawford Plumbing & Mill Supply Co., awarded contract to lay sewer mains on streets to be permanently paved, in which present mains are not of a size to meet future demands of property owners on those streets.

**O., Akron**—Columbus Asphalt Paving Co., Citizens Bank Bldg., Columbus, award. contract by city for bldg. brick sewer in S. Main St.—West Thornton St. to south line West Crosier St., at $12,337.

**O., Canton**—F. A. Downs Constr. Co., awarded contract for constr. of the east intercepting sewer.

**O., Cleveland**—City let contracts to M. A. Yahya, 3539 Independence Rd., for bldg. sewers in Severn Ave., at $2,297; Joseph & Kalill, 1200 Bolivar Rd., Clyde Ave., etc., at $1,439; St. Olga Ave., at $1,949; A. J. Galvin, 357 Lennox bldg., St. Hichan Ave., at $1,978; Fredericks & Housaine, 535 Bradley Court, Clarence Ave., at $5,137.

**O., Cleveland**—City let contracts to D. Pfahl, 724 Guardian Bldg., for bldg. sewers in Parkgrove Ave., east 156 to 161st Sts., at $4,861; Hale Ave., $3,657; Sylvia Ave., at $11,931; Huntmere Ave., at $4,720; Grove wood Ave., at $4,889; A. C. Hattendorf, 13601 6th Ave., at $3,377; Water & Sewer Impvt. Co., 345 The Arcade, Damon Ave., at $2,936; Corsica Ave., at $2,770; A. Marra, 610 Park Bldg., East 140th St., at $4,603.

**O., Cleveland**—Aftoora & Joseph, 887 The Arcade, awarded contract by city for bldg. sewer in East 96th St.—Seminole to Lowell avenues, at $810; East 61st St., also Ada Ave., to Fredericks & Housaine, 635 Bradley Court, at $414 and $1,164, respectively; East 76th St., to E. Cesa & Son, 2462 Baldwin Rd., at $2,289; St. Clair Ave., to P. Ciraci, 11811 Browning Ave., at $7,016; E. 130th and 131st St., to Iannetta Bros., 2064 East 12th St., at $3,830 and $3,634, respectively; Lowell Ave., to B. P. Gibbons, 340 Leader-News Bldg., at $979; Adelbert Rd., to W. Nichols & Son, 11422 Fairchild Ave., at $19,008; E. 18th St., to P. W. Graham, 1274 E. 108th St., at $26,431.

**O., Salem**—Jones Construction Co., city, awarded contract for constr. of additional filtration beds at city disposal plant, west of city, at $30,800.

**O., Troy**—Pat Sweeney, awarded contract for constructing sanitary sewer on Pennsylvania avenue from Simpson to May; on May from Pennsylvania to Baltimore & Ohio railroad branch line.

**Okla., Ada**—Comstock & Hanson, Tulsa, awarded contract by city to contsruct sewers at $27,400.

**Okla., Heavener**—Green Constr. Co., Miami, Okla., awarded contract for sewerage system here.

**Pa., College Hill**—George Co., Youngstown, awarded contract at $32,800; also F. Elder & Ferry, New Castle, Pa., at $39,-300, for work in construction of sanitary sewage system for Boro.

**Pa., Erie**—W. Bancroft, Jr., awarded contract for constr. of sewer in Goodrich St., at $2,750.

**Pa., Pittsburgh**—Manella Construction Co., Pittsburgh, awarded contract by city for installing sewers in Jackson street at $979; Baltimore & Ohio property and Ethel street, to M. O'Herron, First and McKean streets, at $7,247 Methyl street, to F. & F. Diulus; 40 Boundary St., at $12,095; Soho Playgrounds to J. Bellisario, at $1,958.

**S. C., Fountain City**—A. H. Guion & Co., Gastonio, N. C., awarded contract to construct sewer and water works systems, at abt. $65,000.

**Tex., Dallas**—Texas Bithu. Co., Dallas, awarded contract to construct storm-sewer on Oakenwald St.—Beckley to Plowman St.—at $6,300.

**Tex., Dallas**—Klein Bros., awarded contract for constr. of storm sewer in Oak Cliff district, at $17,000.

**Tex., Dallas**—Klein Bros., awarded contract by city to construct storm-sewers on Fairmount street—Welborne to Wolfe streets; also on Wolfe street—Fairmount to Maple Ave—at $20,757.

**Wash., Coules City**—J. C. Broad, Spokane, awarded contract by Council for constr. of city sewer, at $32,695.

**Wis., Green Bay**—Chas. P. Flatley, award. contract for sewer: 1,952 ft., 12-in. vit. pipe, $1,415; 630 ft. 12-in., $1,565; 552 ft. 12-in., $1,545; 310 ft. 12-in., $1,565; 1,035 ft. 12-in., $1,475; Jim Brogan, awarded contr. for sewer on Clinton St.: 186 ft. 12-in., $1 per lin. ft.; 668 lin. ft. 12-in., $1.60 per lin. ft.; 225 ft. 12-in., $2.50 per lin. ft.; 1,076 ft. 24-in. vit. or conc., $2.60 per lin. ft.; 536 ft. 20-in. vit. or conc., $2 per lin. ft.; 774 ft. 18-in., $1.80 per lin. ft. Ben Waerzeggers, contr. for sewer in School Pl.: 290 ft. 12-in., $1.23; 170 ft. 12-in., $1.30; 700 lin. ft. 12-in., $1.29. W. W. Reed, city engr.

**Wis., Milwaukee**—F. H. Nakielski Co., awarded contract for constructing sewer to connect with city sewers with Jones Island sewage disp. plant, at $134,276.

**Wis., Manitowoc**—W. O. Bahr, 10th St., awarded contract for excavating and laying 3.7 miles of sewer in 8th street, Langdon Ave., to city limits, at $36,670.

**Wis., Milwaukee**—Geo. E. Zimmerman Co., awarded contract for installing connecting structures betw. old city sewers and new intercepting sewer, in connection with sewage disp. system, at $48,375.

**Wis., Sheboygan**—South Side Hardware Co., 1512 So. 12th street, awarded contract by Bd. Public Works for bldg. 2.8 miles sewer in N. 3rd St.—Bluff to Bell Aves.; also Geele Ave., N. 3rd to N. 6th Sts., involving 3,710 lin. ft. 8-10 in. vitr. pipe, at $12,577.

## WATER SUPPLY AND PURIFICATION.

**Cal., Arcadia**—Western Pipe and Steel Co., 1756 North Broadway, Los Angeles, awarded contract for furnishing and laying 3,000 ft. 12-16 in. riveted steel pipe in Santa Anita Ave., at $5,094.

**Cal., Oildale**—Bd. Supvrs., Kern Co., Bakersfield, will build water system by day labor. Cost, using c. i. pipe, $34,890; soft steel pipe, $25,850. Work involves drilling wells, laying mains and laterals and providing for fire protection; $20,000 bonds voted for project and $20,000 additional bonds will be voted. A. E. Stegeman, Bakersfield, County Surv.

**Ky., Dawson Springs**—Railroad Water and Coal Handling Co., Chicago, awarded contract by Illinois Central R. R., Chicago, for constructing conc. dam across Tradewater River to supply water for pumping station; dam of conc. 14 ft. high, 125 ft. long, and 19 in. thick, costing $6,000; also let contract to same company to erect a pumping station 27x27 ft., 1 sty., brk., with conc. fdn. and slate roof; machy. to consist of two 2-HP. fuel-oil engines having belt connections with two 500 R. P. M. centrif. pumps, discharging through 3,000 ft. 10-in. c. i. main pipe into 100,000-gal. tank.

**Mass., Boston**—Hugh McNulty, awarded contract for laying and relaying water pipes in Main street and Mystic avenue, betw. Bunker Hill and Sherman Sts., at $3,440.

**Md., Cumberland**—Vang Construction Co., awarded contract for replacing with concrete pipe, portions of water line from Lake Gordon to the city limits.

**Minn., Bemidjt**—Lane & Bowler Co., Memphis. Tenn., awarded contract for installing deep well pumping system here.

**Mo., Kansas City**—Tifft Construction Co., Buffalo, awarded contract for constructing a one million gal. rein. conc. standpipe at 75th and Holmes streets, at $52,000.

**N. J., Jersey City**—Snare & Triest, awarded contr. for laying 30-in. water mains on the meadows under the Hackensack river, at $372,000.

**N. Y., Corning**—W. F. Martens Co., Rochester, N. Y., awarded contract for rein. conc. top at Pine Street reservoir, at $16,000.

**N. Y., Poughkeepsie**—W. W. Kingston, Poughkeepsie, awarded contract for constructing rein. conc. water purification plant here and placing all pipe valves, strainer, etc., at $14,812.

**N. C., High Point**—City awarded following contracts at total of $86,650 for water plant near Jamestown on Deep river: R. K. Stewart & Son, Farmville, Va., at $59.930, to install filter equipment; Pittsburgh Meter Co., Pittsburgh, Pa., at $21,400, to install filters; Morris Machine Works, Baldwinsville, N. Y., at $4,320, to furnish pumps and motors.

**Ohio, Columbus**—Dravo-Doyle Co., Cleveland & Pittsburgh, awarded contract for installing equipment in water booster station in Chittenden Avenue, at $10.634.

**Ohio, Freeport**—T. C. Brooks & Sons Co., Jackson, Mich., awarded contract for furnishing material and constructing certain impvts. to existing municipal water works system, including 1½ miles trenching and pipe laying, and furnishing 100 tons c. i. pipe at $13,000.

**Ohio, Toledo**—S. L. Cothrel, Ohio Bldg., awarded contract by Commrs. Lucas county for laying 7,720 ft. 6-in. c. i. pipe in Water Line No. 4, Overland Heights, at $12,678.

**S. C., Fountain City**—A. H. Guion & Co., Gastonia, N. C., awarded contract to construct sewer system and water works at abt. $65,000.

**S. D., Mitchell**—City let contracts, constructing water works (2 sects.) (a) Sect. 1, pump station bldgs. & well houses, (b) Sect. 3, laying 12,700 ft. 4, 6 & 8 in. c. i. watermains, installing 13 fire hydrants,

special castings, 7 manholes, to Brown & Kings, Mitchell, at $15,182; $2,400 and $11,-757, respectively; Sect. 2, machinery, Sect. 7, stack, to Merkle Machinery Co., 508 Interstate Bldg., Kansas City, Mo., at $38-000 and $2,200, respectively; Sect. 5, air-lift, to Harris Air Pump Co., 421 W. South St., Indianapolis, Ind. (a) $13,339, (b) $10,-877; Sect. 6, deep wells, to R. W. Jamison, Mitchell, $1,909; (b) Sect. 2, furnishing 205 tons 6-8 in. and 16 tons 4-in. c. i. pipes, 12 ft. lengths, 6,597 lbs. special castings to Natl. Cast Iron Pipe Co., Tarrant City, Birmingham, Ala., at $13,030.

**Tex., Houston**—J. E. Roberts, 3604 Barnes St., city, awarded contract drilling to augment water supply at central pumping plant to produce 400,000 gals. every 24 hrs., and one that will bring 550,000 gals. to the surface every day.

**Va., Hampton Roads**—Memphis Steel & Constr. Co., Pittsburgh, Pa., awarded contract by Government for constructing tower and tank at Langley Field, at $22,-000.

**W. Va., Bakerton**—Ambursen Construction Co., 61 Broadway, N. Y., awarded contract by Bakerton Water Co., to construct water works, including 30 ft. conc. dam, gatehouse, filters and 1½ miles c. i. pipe line to city.

## BRIDGES AND BUILDINGS.

**Ill., Cisna Park**—Breese Mfg. Co., Mattoon, Ill., awarded contract for constructing one rein. conc. bridge betw. Artesia and Pigeon Grove Twps., at $2,490.

**Ill., Metropolis**—J. R. Sleeter, city, awarded contract for constr. of five bridges (concrete) to be built through the Edward's bottoms in eastern part of county, at $4,000.

**Ill., Pekin**—Edward Cooney, Tremont, awarded contract for bridge over ditch in Sand Prairie Twp., at $1,268.

**Ill., Springfield** — Following contracts awarded for bridge construction: Bresee Road Supply Co., Mattoon, Ill., contr. for brdg. known as 61-62 betw. Artesia and Pigeon Grove Twps., Iroquois Co., at $2,-490; C. O. Capperrune, Bradford, Ill., Hickey brdg., Osceola Twp., Stark Co., at $1,-919; Chas. J. Behler, Oregon, Ill., Failon & Jackson bridges, Elmira Twp., Stark Co., at $5,390; H. C. Nieland, Zirzow brdg., Monee Twp., Will Co., at $1,749; D. M. Dean, Lacon, Ill., Landers brdg., Whitefield Twp., Lacon, Marshall Co., at $2,703; James Shinn Co., Elliott & Roche brdgs., $4,995.

**Ill., Springfield**—Following contracts for bridge construction awarded by Dept. Pub. Wks. & Bldgs.: Singler brdg., E. Marion Twp., to B. F. Clark & Son, St. Louis, at $2,970; Little Crab Orchard brdg., E. Marion Twp., Williamson Co., to Barham Constr. Co., East St. Louis, Ill., at $3,797; Contrary Creek brdg., Sec. C, Hamilton Co., to Barham Construction Co., East St. Louis, at $4,997; 9 bridges in Sec. D, Pope Co., award. to B. F. Clark & Son, 5052 Gates Ave., St. Louis, Mo., at $2,300; 5 bridges in Massac Co., Sect. G, to J. R. Sleeter, Metropolis, Ill., at $3,900; Bentler bridge, Sec. H, Scott Co., to Thos. Whitlock, Exeter, Ill., at $2,400.

**Ill., Springfield**—Northern Steel & Concrete Co., Freeport, awarded contract for Frank Berg bridge in Caledonia Twp., Boone Co., at $5,062.

**Ill., Toulon**—Chas. J. Bekler, Oregon, Ill., awarded contract for constructing rein. conc. bridges in Elmira Twp., to be known as the Fallon and Jackson bridges, at $5,-390; C. O. Copperrine, Bradford, Ill., award. contract for constructing the Hickey bridge in Osceola Twp., at $1,919.

**Ind., Anderson**—Kelly & Son awarded contract for bldg. brdg. across Killbuck near Union Traction power house, at $1,-935, one over Noble Ditch north of Elwood at $1,150, and one near Summitville at $875; Burke Constr. Co., awarded contract for bldg. Orestes bridge at $1,050.

**Ind., Boonville**—International Steel and Iron Co., Evansville, awarded contract for constructing two steel bridges, at $1,440.

**Ind., Greenfield**—Following awarded contracts by Hancock County Commrs. for constructing 14 bridges and bridge repairs; A. F. Hooton & Son, Greenfield; Roy Crider, Greenfield; Kattman & Hancock, Brownstown, Ind., and Oliver Richey, Greenfield.

**Ind., Peru**—Following contracts for brdg. construction let by Co. Commrs.: Brdg. No. 1-19 over Eel river, Richland Twp., to Frank M. Hoffman, Rochester, at $18,959; No. 2-19 over Strebe ditch, Allen Twp., steel wk. to Hoffman, at $1,237 and conc. constr. work to J. B. Goodall & Sons, at $1,821; No. 3-19 over Strebe ditch, Allen Twp. steel wk. to Hoffman, at $1,097 and conc. wk. to Goodall, at $1,758; No. 4-19 over Strebe ditch, steel wk. to Hoffman at $1,097, conc. wk. to Goodall, at $1,419; No. 5-19 over Kerchner ditch on Julius Pritz Rd., Union Twp., steel wk. to Hoffman at $1,884 and conc. wk. to Goodall at $1,379; No. 6-19 over Pipe Crk., Jackson Twp., steel wk. to Hoffman at $7,900 and conc. wk. to B. F. Hatfield, at $2,385; No. 7-19, Jefferson Twp., steel and conc. to Wm. J. Norris at $900; No. 8-19, Richland Twp. on Boswell Rd., to W. J. Norris, steel and conc., at $1,437.

**Ind., Wabash**—Ira B. Heagy, awarded contract for constr. of No. Wabash street bridge at $2,982.

**Ind., Shelbyville**—Haymond & Howard, awarded contract for repair of the Fairland bridge on Bush road in Brandywine Twp., at $2,487.

**Ind., Washington**—Vincennes Bridge Co., awarded 9 contracts for bridge construction by Daviess County Commrs., aggregating $19,320. Bridges are as follows: Stanley, Bogard Twp., $750; Banta, Steele, $575; Berrine, Steele, $2,225; Barnard, Steele, $2,248; Wells, Steele, $2,248; Graham, Washington, $2,038; Keith, Steele, $3,348; Straightline, Steele, at $3,954; McCarter, Madison, $1,319, and Satterfield brdg., Barr, at $1,465.

**Ind., Winchester**—Harry Iliff awarded contract for constr of bridge across Mississinewa river near Union City by Comrs. Darke County, Ohio, at $867; Constable and Rhodes, contract for bridge over same river at $4,175.

**Ia., Ames**—Following contracts awarded by Iowa State Hwy. Comn., for brdg. construction: T. J. Wagner, Swea City, Ia., 1 conc. slab, 1 conc. deck gird. and 1 conc. I-beam for $6,092; A. Olson Constr. Co., Waterloo, 2 conc. deck girders, 1 conc. slab and 1 conc. box culvert, at $12,722; Fifield Construction Co., Waterloo, 1 L-beam and 1 conc. slab for $5,286; N. M. Stark & Co., Des Moines, 1 brdg., composed of 3 65-ft. steel pony trusses, 1 concrete abutment and conc. piers, at $1,600 and 1 rainbow conc. arch for $13,580; Des Moines Bridge & Iron Co., Des Moines, 1 156-ft. steel span to be erected on tubes already in place at $8,690.

**Ia., Chariton**—Des Moines Bridge & Steel Co., Des Moines, awarded contract for constr. of bridges in Lucas county, at $14,-500.

**Ia., Council Bluffs**—Wickham Bridge & Pipe Co., Council Bluffs, awarded contract for constructing 8 bridges and culverts at $22,449.

**Ia., Davenport**—George Shelton, Davenport, awarded contract for bldg. 18 new bridges for Scott county, at $24,998.

**Ia., Des Moines**—Geo. E. Lambert & Co., awarded contract to build concrete culverts in Washington Twp., one on Ames Road and another on White Pole Road, at $15,289.

**Ia., Grundy**—Following contracts awarded by Commrs. Grundy County: bldg. 7 conc. box culverts and 1 conc. slab brdg., to F. Fuller & Son, local, at $3,157; 3 conc. box culverts, 3 I-beam bridges and 1 pony truss bridge, to Des Moines Brdg. & Iron Co., Tuttle St. (betw. 9th and 11th) Des Moines, at $15,656. Work involves 36½ tons struct. and 20½ tons reinforcing steel; also 667 cu. yds. rein. conc.

**Ia., Independence** — Following contracts awarded by Board of Supvrs. for furnishing 63 concrete bridges: F. E. Reinhold at $12,131 and J. B. Elliott, at $11,245.

**Ia., Onawa**—J. P. Riddle, Creighton, Neb., awarded contract for bldg. 11 concrete box culverts, 1 concrete slab bridge and 2 concrete headwalls, at $12,793.

**Ia., Sigourney**—J. Ritzinger, Sigourney, awarded contract by Commrs. Keokuk Co., for bldg. 37 concrete box culverts and 1 concrete circular culvert at $23,268.

**Ia., Waverly**—C. H. & J. H. Russel, Waverly, awarded contract by Bd. of Supervisors Bremer Co., for bldg. bridges in various townships at $18,681.

**Mass., Holyoke**—Eastern Bridge & Structure Co., 88 Crescent St., Worcester, awarded contract by Bd. Pub. Wks., for bldg. deck steel girder bridge over levee canal on Appleton St. (steel work encased with rein. conc.) at $28,400.

**Mich., Bessemer**—R. L. Erickson awarded contr. for bridge over Black River at Ramsey. Gogetic Co., 1 45 ft. conc. arch., at $10,296.

**Mo., Granby** — Joplin Concrete & Steel Constr. Co., Independent Bldg., awarded contract by Commrs. Newton Co. (Neosha) for bldg. 200 ft. rein conc. bridge, 18 ft. wide, over Shoal Creek on Granby-Diamond Road, 3 miles north of here, at $14,-600.

**Minn., St. Paul**—Illinois Steel Bridge Co., awarded contract for reinforcing and repairing Robert Street bridge at $9,125.

**Mont., Billings**—Security Bridge Co., local, awarded contract (general) for south end of Laurel Bridge, at $8,925.

**N. J., Cape May**—S. G. Corson, Ocean City, awarded contract for bldg. conc. brdg. over Cedar Swamp Creek, at $15,365.

**N. J., Gloucester**—E. P. Henry & Son, 98 Green St., Woodbury, N. Y., awarded contract for several conc. bridges at $33,-561.

**N. D., Fargo**—J. A. Jardine, city, awarded contract for constructing brdg. over Wild Rice river and over Ross Coulee, at $25,262.

**Ohio, Bryan**—Rochester Bridge Co., awarded contract for bldg. superstructure of Lockport bridge at $8,174; C. R. Harmon, Bryan, contract for substructure, at $4,594; Rochester Bridge Co., also secured contract for Bridgewater Center bridge at $5,982. All the brdgs. will be of steel.

**Ohio, Cleveland**—McKisson Co., awarded contract to bore necessary foundation excavation in Hillside and Valley for the new Huron-Lorain high level brdg., at $7,500.

**Pa., Philadelphia**—Phoenix Bridge Co., Phoenixville, Pa., will be awarded contract at $176,399 for erection of superstructure of Frankford L line, as soon as schedule of bids is completed. Bid includes furnishing of steel.

**Pa., Wehrum**—M. Bennett & Sons awarded contract for bldg bridge over Black Lick Creek, at $18,973.

**Tex., Dallas**—Klein Bros., Dallas, awarded contract to construct concrete bridge over Turtle Creek on Fairmount streets, at $29,120.

**Va., Accomac**—Tampa Sand & Sheet Co., Tampa, awarded contract for constructing bridge connecting Chicoteague Island with mainland of Accomac county; wood struct., 1,600 ft. long with 21,000 ft. of fill, to cost approx., $100,000.

**Wash., Seattle**—Hansen and Hauge, awarded contract by Board of Public Wks. for construction of Fairview Trestle Roadway, at $17,908.

**Wash., Toledo**—Pacific Iron Works, Portland, Ore., awarded contract for constructing new Pacific Hwy. brdg. over Cowlitz river, including 4-180 steel spans on concrete piers with concrete approach, at $128,922.

**Wis., Madison**—Fess & Fess, awarded contract for improving Dunkirk Ave., and Page St., at Stoughton, Wis., at $3,078 and $6,625, respectively.

**Wis., Oshkosh** — Following contracts awarded by County State Rd. & Brdg. Commn: Louis A. Larson, contr. for bldg. Skeleton brdg., 30 ft. span; towns of Oshkosh and Vinland, at $2,910; Morris Martin, Berlin, Wis., Canal bridge, 18 ft. span, town of Poygun, at $1,450 and Louis A. Larson, Scovel bridge 8 ft. long in Winneconne, at $962.

**Wis., Oshkosh**—Adolph Green Construction Co., Green Bay, Wis., awarded contract for constructing bridge across Fox river at Oregon and Jackson Sts., completing and removing old substruct., constructing piers, fenders and abutments, retaining walls, hand railing, filling, paving approach rdway, constructing deck hwy. brdg. superstruct., consisting of 6 approach spans, and one Scherzer Rolling Lift Span, at $172,745.

**Wis., Wild Rose**—C. Radley, Wautoma, awarded general contract for River St. bridge, at $1,398; also Willow Creek brdg., in town of Springwater, at $1,059.

# PROSPECTIVE WORK

## ROADS AND STREETS.

**Ariz., Tombstone**— Special election to vote on issuance of $1,000,000 bond for constr. of improved hwys., Cochise county, will be called by the supervisors in response to demand from taxpayers; bond issue will cover following: Central hwy.—Douglas to Willcox by way of West Wells, Pearce, Cochise to Wilcox, 68 miles. Est. cost $475,000; Road from Benson north to Dishom county line, 6 miles, $30,000: from Benson north 20 miles, $150,000; road from jct. of Hereford-Naco road to Forest Reserve in Ramsey Canyon, 28 miles: $450,-000; Forest ranch to Gleeson, 19 miles and surface Double Adobe road, 8 miles; $140,-000; road from West Wells to Chiricahua mtns., 19 miles, $50,000; road from point on Borderland route near Ariz.-New Mex. state line to connect with Hill Top road, 10 miles. $60,000.

**Ark., Sheridan**—Grant County Commrs., have plans by State Hwy. Department, Lit-

tle Rock, for 23.98 miles of highway—Sheridan to Jenkins Ferry, 12 ft. wide, 6-in. thick, 22-ft. embankment, $111,736.

**Cal., Richmond**—City will undoubtedly construct 6 miles of paving this year; also considering constr. of 29.8 miles of sewers of which amt. 6 miles are certain to be built. H. D. Chapman, city engr.

**Cal., San Diego**—Council has adopted resolution of intention to pave More blvd., betw. Old Town and Pacific Beach, about 3½ miles.

**Cal., Stockton**—Following improvements to be made in Stockton this year: 1,000,000 sq. ft. bithu. pavement; 36,000 lin. ft. curbs and gutters (concrete); 17,500 sq. ft. concrete walks; 500 lin. ft. steel sheds and waterfront; 1,000,000 sq. ft. oil and screenings. H. T. Compton, city engr.

**Cal., Vallejo**—City expects to grade, pave, construct sewers and walks on about one-half mile of Hichborn street, at total cost of $50,000. Pavement and walks will be of concrete; sewers (ironstone), with outfall in Bay, Mare Island Channel. T. D. Kilkenny, city engr.

**Colo., Denver**—State Highway Commission will soon start work on 20 miles of road in Big Thompson canyon to cost about $90,000. Maximum grade of present road of 15 per cent. will be cut to 7 per cent. under new plan.

**Fla., Quincy**—City will pave 20 blocks; $40,000 available. Voted $50,000 bonds for one-third expense. E. M. Collins, Chrmn. council.

**Ga., Amercus**—Sumter County Commrs. have engaged Thomas & Hawkins, engrs., Atlanta, to make surveys prep. to constructing roads; expend $1,000,000.

**Ark., Pine Bluff**—Jefferson County Commissioners have engaged Parkes Engrg. Co., as engineers for road construction near Plumerville, $250,000.

**Ga., Fort Valley**—$24,000 bonds voted by city for 20,000 yds. street paving; expend $72,000, two-thirds to be contributed by property owners. H. C. Neil, mayor.

**Ida., Boise**—Approval of plans for completing last of most impassable stretches in North and South highway given by Fed. Bureau of Roads. Sections extend abt. 30 miles through Adams and Idaho counties on 67-mile stretch, betw. New Meadows & Whitebird; $649,000 est. cost and fed. aid to extent of 50 per cent. has been asked.

**Ill., Lincoln**—About $18,000 worth of vitr. brick paving will be put down in Lincoln this year. Plans also being considered for some macadam-tarvia construction on outlying streets of city. Edw. J. Tobin, city engineer.

**Ill., Ottawa**—About $3,800,000 will be expended in LaSalle county for good roads betw. Ottawa and LaSalle. Of this amt., $3,000,000 will come from state bond issue and $800,000 from government.

**Ill., Paris**—Petition filed in county court for a $38,000 pavement improvement in city of Chrisman. Pavement will be of brick and connect two railway stations.

**Ill., Waukegan**—State Dept. has approved plans of Chas. Russell, Co. Supt. of Rds., for paving of Belvidere street—Waukegan to a point 12 miles west of here. Supt. plans to call for bids immediately. Est. cost of impvt., $300,000.

**Ill., Wood River**—Village contemplates paving one mile of streets. W. I. Jolley, village engr. Bd. of Local Impvts. has also passed resolutions for an extension to water and sewer systems. Aggregate cost of work on both systems, $35,000 (abt. $16,000 for the water system).

**Ind., Akron**—Town may construct sanitary sewers and put in about 10 blks. of paving. A. C. Davisson, city engr. Rochester, Ind., may also do some paving this year; also build city hall which is estimated to cost about $80,000. A. C. Davisson, city engr.

**Ind., Plymouth**—Plans and specfs. for paving Plum Street, including sewer impvts., passed by council. Pavement will extend from Jefferson to Harrison, be 30 ft. wide including curb, laid on earth and sand fdn. Est. cost $12,069, or $3.98 per ft.

**Ind., South Bend**—Bd. Public Works and Park Bd. have reached an agreement on the paving and extending of Calvert St., through Studebaker Park. Culvert will also be built over Bowman Crk. on Calvert street, and will cost $6,500. Bids to be asked soon.

**Ind., Sullivan**—Petition filed with County Aud. Frank M. Daniels, signed by 97 freeholders in vicinity of Dugger, asking for conc. hwy., from Sullivan; Green County line to city of Sullivan—about 10 miles.

**Iowa, Adair**—Town Council considering resolution of intention to improve various streets in town—about 12 streets. Ernest Freese, Clk.; J. Cowden, mayor.

**Iowa, Clinton**—City will put in 10,000 sq. yds. brick paving concrete curb and gutter, 10,000 lin. ft. J. G. Thorne, consult. engr.

**Iowa, Creston**—Resolution passed for abt. 30,000 yds. paving. Council now has further proceedings under advisement. Theo. S. DeLay, consulting engr. Resolution also passed for abt. 25,000 yds. paving and further proceedings being prepared.

**Iowa, Marengo**—City will put in 101 blocks of paving during 1919, at est. cost of $300,000.

**Iowa, Reinbeck**—City will pave 38,000 sq. yds. J. G. Thorne, Consult. Engr.

**Iowa, Webster City**—C. H. Currie, consulting engr., Webster City, Iowa, reports that he has the following projects in hand which will no doubt materialize: six sewerage and sewage disposal systems which will cost about $32,000 each; also two costing about $60,000 each; three paving projects which will cost approx., $500,000.

**La., Winnsboro**—$750,000 bonds voted for hwy. improvements; Government and state aid will make $1,500,000 available.

**Maine, Bath**—City government passes appropriation of $425,423.89 for improvement work during 1919; $138,850 is amt. allotted to Bd. of Hwys. and Sewers; $66,800 for permanent streets.

**Maine, Dover**—Board of County Commrs. for Piscataquis county proposes to see that nine miles of road through forest from MacFarlane farm at Greenville to Lily Bay will be constructed this summer.

**Mich., Houghton**—Keweenaw Co. Rd. Comn. planning to proceed with extensive impvts. this summer. It is proposed to resurface roads from Ahmeek to Cliff Mine and complete Arnold Rd. to Eagle Harbor and Madison Hwy.

**Mo., Independence** — Jackson County Court has approved plans for grading Washington Park Blvd.—Kansas City to Mount Washington; $80,000. This includes grading, draining and brdg. constr. O. C. Shelby, hwy. engr.

**Miss., Pascagoula**—Municipal councils of Moss Point and Pascagoula propose bldg. 5 miles 18-ft. wide concrete highway from Pascagoula to Randalls Ferry; $100,000. Federal Govt. to contribute $25,000; supvrs. of Beats 2 and 3 will issue $75,000 bonds.

**Mo., St. Louis**—Vandeventer Avenue is to be made an 80-ft. hwy., according to plans prepared by St. & Sewer Direct. Talbert, who has begun preliminary work for this impvt., which will connect North and South St. Louis; est. cost, $170,000; plans also drawn to link Skinker road with McCausland Ave. on south and Hodiamont avenue on north, to make a thoroughfare from Easton to Manchester avenues. This project will involve the raising of a viaduct and raising of the railroad tracks over a connection with Hodiamont avenue north of Delmar boulevard. This department is working on 39 improvements authorized by Board of Aldermen.

**Neb., Omaha**—City Commr. Towl.—Dept. of Public Impvts. is working on plans with conjunction of City Planning Commn., for the development of a new 80-ft. driveway from 32d and Grover streets to 33d and L streets, about ¾ mile.

**N. J., Bayonne**—City will improve about 20 different streets. Est. amt. of work involves: 58,000 sq. yds. asph. paving and 8,500 sq. yds. granite block paving. Walter L. Clarkson, city engr.

**N. J., East Orange**—City plans to lay one mile sheet asph. on old Telford base and about 3 miles of Bithulithic on old Telford base this year. W. D. Willigerod, city engr.

**N. Y., Corning**—City contemplates expenditure of $30,991.49 for paving this year. M. O. Drake, supt. Also considering new sewers, $15,000; new water mains, $15,000; recovering South Side reservoir, $15,000; conc. swimming pool, $15,000.

**N. Y., Olean**—Good Rds. Assn., Bradford, Pa., has offered to build a stretch of road from Pennsylvania state line to Carrolton, N. Y., where New York state road begins, if given permission by the authorities of Cattaraugus county and New York state. Est. cost, $70,000.

**N. C., Marion**—McDowell County Hwy. Commission will construct central hwy. between Burke and Buncombe Co. lines; connecting Asheville, Hickory, Statesville, Salisbury and cities in eastern section of state; extend through Blue Ridge and Black mountains; length, 32 miles. Cost, $200,000 to $300,000. Will purchase road machinery. L. R. Ames, engr., care of Marianna Hotel, Marion.

**N. C., Washington**—Beaufort county has voted $1,000,000 bonds for road construction. F. C. Kugler, chrmn. of commrs.; V. von Gemmingen, engr.

**Ohio, Bexley**—Three bond issues were approved by voters here as follows: $86,000 total to be divided as follows: $17,000 rd. and street impvts.; $45,000 sewer, and $24,000 water pipe extensions.

**Ohio, Bucyrus**—City considering paving of 3 streets, aggregating 10,000 sq. yds. Petitions on file for paving of 16 additional streets. F. L. Niederheiser, city civil engr.

**O., Middletown**—Hydraulic street will be paved with either brk. or asph., without further delay.

**O., Painesville**—13 miles of road betw. Painesville and Geneva will be paved this summer. Est. cost, $450,000.

**Ohio, Sandusky**—Co. Engr. Schultz has prepared the division of costs on Sandusky-Clyde road and the estimates for the improvement. Road will cost approx. $116,000.

**Ohio, Uhrichsville**—Council has voted to expend $90,000 for paving and repair of paved streets in 1919.

**Ore., Tillamook**—Council has adopted resolution for impvt. of streets and avenues in accord. with plans and specfs. prepared by city engr. Est. cost $14,676. Frances B. Stranahan, city recorder.

**Tenn., Livingston**—Overton county will construct hard-surface road from Cooksville to Kentucky state line; $100,000 available. J. B. McDonald, Chrmn. A. M. Nelson, State Hwy. Engr., Nashville.

**Tex., Canadian**—Council has ordered that Main street be paved from Santa Fe depot to 6th street and half block on either side of Main on 1st, 2nd, 3rd, 4th and 5th streets; also 40 blocks of walks will be constructed. Impvts. will cost about $60,000 and will be pushed with all possible speed.

**Texas, Greenville**—A. D. Duck, City Engineer, will have supervision of road and pavement construction to the amt. of $2,400,000 during 1919.

**Texas, Cuero**—$35,000 bonds voted by city for street paving; plans to pave 100 blocks, bond issue to represent one-third of cost.

**Tex., Houston** — City considering following improvements for 1919: Street work, $150,000; sanitary sewers, $50,000; water works extensions, $125,000; schools, $700,000; municipal harbor belt railway extensions, $50,000. Funds for the railway extensions and $100,000 for water works extension now available; also abt. $120,000 from ins. received on acct. of high school burning; the other funds will be provided through bond issues which will be voted on. J. C. McVea, Engr.

**Tex., Livingston**—$800,000 bonds for rd. impvts., voted by Polk county. This, with $200,000 promised by State Hwy. Comn., will give county $1,000,000 to expend on roads. Included in this sum is cost of constructing a highway through the county from north to south, work on which has not started.

**Tex., Lufkin**—Plans practically completed for constr. of 20.5 mi. Fed. mi. Hwy. work in Madison county, involving expendt. of abt. $200,000; preliminary report also filed by P. A. McCarthy & Sons, Consit. Engrs., of cost of constr. hwys. in Road Dist. No. 3, Hardin county; abt. 12 miles of road will probably be improved in this district for which an $800,000 bond issue will be launched; Angelina county also contemplates extensive campaign for a million dollar good roads bond issue. Assn. organized to put through this campaign. Thus far about $30,000,000 voted by various counties in state for road work which will be put through as quickly as possible. P. A. McCarthy & Sons, Consit. Engrs., Lufkin.

**Tex., Marshall**—Harrison county: 135 miles gravel and macadam roads will be constructed in this county. $1,650,000 available. W. H. Strength, Judge.

**Tenn., Nashville**—State Hwy. Dept. will let contracts for road constr., within next 60 days, which will incur expendt. of approx. $500,000.

**Tex., Port Arthur**—City contemplates following construction work during 1919: 41 miles of street impvts., est. $270,000; 1½ miles water extension line; moving a 110,000-gal. capy. water tower and install new pump engine, est. at $35,000; ½ mile sewer extension, est. $2,200. Clarence E. Ridley, City Engr.

**Wash., Onacortes**—City Council has decided to pave 35th street, at a cost of $35,000. It is also proposed later to pave from end of present impvt. to southern boundary of city.

**Wash., Spokane**—More than $1,000,000 will be expended in vicinity of Spokane under supervision of the state hwy. dept., this year. H. J. Doolittle, State Hwy. Engr., has opened offices in Court House to direct Eastern Washington work. In a general way state will direct wk. of expend'g state fed. funds on following section of roads this year: Chewelah exten. of inland Empire Hwy., no. of Deer Park,

$390,000; Spokane county roads to be improved with state & fed. aid, $300,000; Colfax and Dayton, $200,000; Cheney exten. of Central Washington hwy. through Tyler and Fish Trap, $120,000; Uniontown gap, Whitman Co. hwy., $45,000; Oakesdale to Garfield, $50,000.

**W. Va., Lewisburg**—Greenbrier Co., Blue Sulphur District, will construct waterbound macadam road. Est. cost $110,000. F. K. Raderm, Engr.

**W. Va., Parkersburg**—$300,000 bonds voted for street paving and sewer construction. C. A. Musgrave, City Clk.

## SEWERAGE AND SEWAGE TREATMENT

**Ark., Little Rock**—State considering constr. of sewer system to connect state institutions with municipal system. $100,000.

**Cal., Anaheim**—Anaheim and Fullerton will go ahead with plans for a joint outfall sewer to the ocean, regardless of the withdrawal of Santa Ana and Orange from the inter-city project.

**Cal., Calipatria**—Construction of sewer system for Calipatria being considered by city trustees.

**Cal., East San Diego**—Olmstead & Gillelen, Hollingsworth Bldg., Los Angeles, retained by city to prepare plans and specfs. for sewer system and municipal water works for East San Diego. Comb. projects will cost about $400,000.

**Cal., Hanford**—City Engr. has been instructed to make estimate of cost of a 14-in. sewer from west county road to Irwin street to serve the California Packing Co., and other industrial plants.

**Cal., Oakland**—City may construct outlet sewer at foot of Seventh street. Est. cost abt. $130,000. Perry F. Brown, City Engr.

**Conn., Greenwich**—House took from table and adopted a bill authorizing Greenwich to construct sewage disp. plant.

**Conn., Ridgefield Boro (Bridgeport)**—At largely attended meeting of legal voters it was decided that Boro shall have additional sewer facilities. $20,000 appropriated for bldg. new sewer and purch. of fire truck.

**Fla., Chipley**—Geo. W. Simons, Jr., Chf. Sanitary Engr. of State Board of Health, Jacksonville, will go over plans with officials of Chipley, for municipal sewerage system which town is planning to install.

**Fla., Chipley**—$60,000 bonds voted to construct sewer system.

**Ga., Columbus**—With site selected, plans drawn and all arrangements completed, work on second sewerage disp. plant for city, will commence at an early date; it is estimated new water line will be about 2,000 ft. long. Plans were drafted by A. E. Gorman, Asst. Sanitary Engr. to Fort Benning Extra Cantonment Zone.

**Ga., Swainsboro**—City voted $50,000 bonds to construct sewer system and water works.

**Idaho, Nampa**—Resolution passed by Council in favor of an extension of the sewerage system and constr. of septic tank. Est. cost $80,000.

**Ill., Chicago**—Pres. Peter Reinberg, of the County Board, has recommended to the Engrg. Div. of Sanitary Distr. that constr. of sewerage system at Oak Forest Infirmary be hastened so as to connect it with the new Sag channel.

**Ind., Columbia City**—Council passed resolution for constr. of sanitary sewers on both sides of Swihart street for entire length of street and running into Blue river at western extremity. Est. cost about $2,500.

**Ia., Council Bluffs**—City Clerk instructed to call for bids for laying sewer on 20th Ave.

**Ia., Cedar Rapids**—Council considering constr. of sewers from river at B avenue to 18th street which will carry it to Fourth street; new sewers at 14th street which will care for Park court district. Sewer at 17th St. will be extended from F to J avenues on upper east side in order to care for the Mound Farm addition.

**Ia., Ft. Dodge**—Council has passed resolution to construct sewers in Districts No. 1 and 2; 500 ft. in Dist. No. 1; all wk. to be of 8-in. pipe with 5 manholes and one flush tank; in Dist. No. 2, 8-in. pipe with 6-in. house connections, 4 manholes, one lamphole and one flush tank.

**Iowa, Garner**—City will lay seven miles of sewers this year. J. G. Thorne, Consult-Engr.

**Ia., Schleswig**—Citizens have petitioned for sewerage system; practically all property owners have signed in favor of construction and matter is being considered by Council.

**Ia., Sioux City**—City Clk. instructed to advertise for bids for constr. of 8-in. sanitary sewer in Fourth street—Nebraska to Virginia street.

**Mich., Detroit**—City considering constr. of sewer on Holmes street; also extending storm sewer. E. J. Bestick, City Clk.

**Mich., Ford (Wyandotte P. O.)**—Village having plans prep. by M. L. Brown & Son, Engrs., 823 Chamber of Commerce, Detroit, for bldg. 250 ft. 39-in. iron pipe sewer outlet, supported on wooden piles with wooden sheet piling and concrete saddles, cinder fill betw. sheet piling. About $10,500.

**Mich., Sturgis**—Town expects to construct 9,000 ft. sanitary sewer and 1,500 ft. storm sewer; also dredge 8,000 ft. drainage ditch to afford sufficient outlet for sewage disposal plant. Geo. A. Eagleton, City Civ. Engr.

**Miss., Clarksdale**—$300,000 voted by city to improve sewer, water and electric systems, pave streets, etc.

**Mo., Holden**—City having plans prepared for sanitary sewer system. Archer & Stevens, Engrs., 609 New England Bldg., Kans. City, Mo. O. G. Boyse, Mayor.

**Mont., Cutbank**—$48,000 bonds recently voted by taxpayers for purpose of installing complete sewerage system.

**Neb., Wayne**—Special elec. to be held to vote on $37,000 bonds for storm sewers.

**N. C., Morganton**—City considering issuance of $10,000 for sewer extension.

**O., Chillicothe**—City considering following sewer work: 1,138 ft. 40-in. storm sewer; 220 ft. 36 in., 336 ft. 12 in. Approx. cost $5,700; san. sewer laterals, 8-in., 6,000 ft., $9,500. H. M. Redd, City Civ. Engr., City Building.

**Ohio, Lima**—City Council has passed ordinance to proceed with the constr. of the $590,000 Collett street relief sewer. Serv. Director authorized advertise for bids and let contract at earliest possible day. This is final step toward erecting sewage disp. plant and purifying the Ottawa river.

**Ohio, Shadyside**—Initial steps have been taken to have local sewerage system. Village will be divided into districts and system may be installed by districts or as a whole.

**Okla., Frederick**—City will construct sanitary sewers; issue $160,000 bonds. D. W. Womack, City Clk.

**Okla., Pauls Valley**—City revising plans for impvt. to sewer and water works systems. W. E. Moore, Engr., 1006 Oil Exchange Bldg., Okla. City.

**Okla., Tulsa**—City Commrs. have plans and specfs. by H. H. Wyss, City Engr., for sewer system for West Tulsa. Est. cost, $31,000.

**Ore., Marshfield**—Resolutions adopted by Council of North Bend for bldg. sewer system over Porter Hill and in that sect. of city. Est. cost $23,859. City Engr. R. L. Cavanaugh instructed to prepare plans and specfs. for improvement of lower Sherman avenue from end of pavement to further end of railroad bridge. This is distance of about 600 ft.

**Pa., Allentown**—City contemplates bldg. sewage disp. plant, with capy. to care for entire city, on 400 acre farm. Work may be done under supervision of H. T. Bascome, City Engr. Farm purchased 3 yrs. ago. Est. cost of work betw. $3,000,000 and $4,000,000.

**S. D., Huron**—Resolution adopted by Council to construct lateral sewers in sewer district No. 52, Dist. No. 53, No. 17 and in Dist. No. 33. J. L. Sanke, Aud.; D. G. Medbery, Mayor.

**S. D., Lemmon**—Engr. Atkinson, Bismarck, N. D., has completed preliminary survey for proposed sewerage system to be installed here.

**S. D., Gregory**—Council has ordered plans prepared and estimates for bldg. sewer system. Consulting Engr. engaged for the work.

**Tenn., Knoxville**—Bill authorizing issuance of $25,000 in bonds for making sewer extensions to Oakwood, introduced in the legislature. It is in the form of an amendment to a bill already introduced which provided for issuance of $100,000 in bonds for sewer and brdg. work.

**Tenn., Nashville**—Board of Commrs. will within a short time let sewer contracts of considerable magnitude—both clay pipe lateral sewers and circular brick trunk sewers. City has about $300,000 available for sewer work. Wm. W. Southgate, City Engr.

**Tenn., Nashville**—Nine ordinances, aggregating in amt. $33,050, to be used for sewer construction, are up before City Comn. for first reading. Money will be used to construct sewers in various sections of the city.

**Tex., Alpine**—City having plans prepared for sewer and water works systems. C. P. Bartlett, Engr., Moore Bldg., San Antonio, Tex.

**Tex., Graham**—Elrod Engrg. Co., Dallas, making topographical maps of city to estimate cost of an up-to-date sewerage system which will be constructed as soon as possible.

**Tex., New Boston**—City, Harvey Miller, Secy., has engaged engineer to survey for sewer system.

**Va., Petersburg**—City contemplates issuing $200,000 bonds for sewer construction, in connection with street paving. R. D. Budd, City Engr.

**Va., Virginia Beach**—City voted $25,000 bonds to improve sewer and water systems. Chas. Barto, Mayor.

**Wash., Seattle**—Resolution asking for trunk sewer on 50th avenue, so., from Brandon to Andover street, passed by Council. Bids soon. Sewer will be 2 mi. long and will serve Lakewood districts.

**W. Va., Cameron**—City considering $60,000 bond issue for sewer constr., paving, etc.

**Wis., Durand**—Plans being prepared for constr. of sewer system and extensions to water works system in city. Druar & Smith, St. Paul, Minn., Engrs.

## WATER SUPPLY AND PURIFICATION

**Ark., Heber Springs**—Hydro-Electric Develop So., Little Rock, plans to begin constr. for hydro-elec. develop. costing $5,000,000; build 3 dams, each 50 ft. high; develop. to include 67 mi. Little Red River, fall of 170 ft. Preparing to test with core drills for first dam site. Dickinson & Watkins, Engrs., Little Rock.

**Cal., Anaheim**—Council has decided to extend 10-in. water mains to So. Olive street. Supt. of power house instruct. to prepare plans. New well may be sunk.

**Cal., Anderson**—H. S. Riddell, Engr., Anderson, recommends that Anderson-Cottonwood Irrig. Dist. strengthen headwk. at bintake on Sacramento River & build laterals, drains, drops and turnouts. $145,000 bonds will probably be voted.

**Cal., Blythe**—Olmsted & Gillelen, Los Angeles, Consit. Engrs. commissioned by city to prepare plans for municipal water works. Approx. cost $36,000. They have also been retained by City Trustees, Huntington Beach, to investigate and report on advisability of establishing a municipal water system and to submit estimates of cost.

**Cal., Calexico**—Money available soon from bond issue (voted sometime ago) for providing an additional pumping capy. and doubling the size of present water system.

**Cal., Los Angeles**—Bd. Public Serv. Comn. contemplates bldg. 23 mi. water pipe to supply aqueduct water to Hansen Heights Dist. Property owners will probably organize impvt. district to build distributing system. J. P. Vroman, Secy. W. Mulholland, 645 So. Olive St., Ch. Engr.

**Cal., Oildale**—Oildale water district will increase its bond issue from $20,000 to $40,000 and work will be started on new water system at once.

**Cal., Whittier**—Plans and estimates for extensions and impvts. to municipal water system, including develop. of new water supply and provision for increased water storage, will be prepared by J. B. Lippincott, 1134 Central Bldg. Est. cost $300,000.

**Ct., Milford**—Milford Water Company contemplates improving plant. About $100,000.

**Conn., Wolcott**—Supt. S. H. MacKenzie, of Water Dept., announces that local dept. will construct new reservoir. Plans call for a lake with capy. of 177,647,872 gals. Land has been purchased.

**Ga., Dawson**—$70,000 bonds voted to extend and improve water works and also to pave business streets.

**Ill., Elmhurst**—Bids will be asked about July 10 by City Clk., for 4 in. to 12 in., c. i. pipe mains. Ed. Hancock, Engr., 2047 Ogden avenue, Chicago, Ill.

**Ga., Summerville**—City will construct $30,000 water system. Plans not completed. Wesley Shroshire, Mayor.

**Ill., Carterville**—Great majority of citizens in favor of construction of water works system. Samples of water taken from old Burr mine and sent to chem. laboratories of Ill. University for analysis.

**Ill., Winnetka**—Town has voted $90,000 for purpose of bldg. filtration plant.

**Ind., Marion**—City considering improvements to water works plant which will cost about $40,000. T. E. Petrie, Pres. Board of Works.

**Iowa, Des Moines**—In addition to 100 miles of water mains unlaid Council today directed Des Moines City Water Co. to install mains in portions of abt. 17 streets.

**Ia., Fort Dodge**—Jno. Pray, City Water Supt. has submitted report to Council urging bond issue of $400,000 to construct filtration plant in Des Moines river as a

means of city water supply. Plant to have capy. of 6 million gals. per day, and to be pumped by electricity by use of hydro elec. power.

**Ky., Ashland**—City having plans prep. by Alvord & Burdick, Engrs., 8 So. Dearborn St., Chicago, for filtr. plant, brk. and reinf. conc.; capy. 2,000,000 gals. E. C. Means, Chrmn. Water Commrs.

**Md., Baltimore**—City will purchase additional site and enlarge filtration plant at Loch Raven; double capy.; present daily water consumption 100,000,000 gals. Walter E. Lee, Water Engr.

**Miss., Port Gibson**—$25,000 bonds voted by city to repair water works and electric light plant.

**Minn., Harmony**—Plans being prepared for new pressure tank and bldg. for water works and for a sewer system for village. Druar & Smith, St. Paul, Engrs.

**Mo., Cameron**—City will construct 500,000-gal. capy. filter plant. E. E. Harper, Engr., 2408 E. 30th St., Kans. City, Mo. Mr. Witt, City Clk.

**Mont., Polson**—Bonds for $15,000 voted for laying 8-in. water mains in St., 6-in. in G St., 3rd St., Hawthorne St., 5th St., D. 1st, Cedar St. and 4-in. in I street. F. F. Faucett, Polson, Engr.

**N. Y., Athens**—Plans being prepared by M. Vrooman, Engr., Gloversville, for bldg. water system, filters, pumping sta., sewerage system and complete sewage disp. plant.

**N. D., Fargo**—Plans approved for new water mains on Broadway from 6th to 11th avenues, N., and 8th Ave., S., bet. 14th and 15th streets. East cost Broadway main, $9,000; 8th avenue main, $1,950. W. B. Stevens, Acting City Engr.

**O., Akron**—Plans under way for constr. of water works at Silver Lake. Est. cost of work, $25,000. Courney Engrg., Co., Cleveland, preparing plans.

**O., Bellefontaine**—Election to be held Aug. 12, for purpose of voting on $110,000 bonds for improvement to water works. Clair A. Inskeep, Direct. of Public Service.

**Okla., Blanchard**—$45,000 bonds voted by city for constr. of water works.

**Okla., Henryetta**—$300,000 voted for water works improvements.

**Okla., Pauls Valley**—City revising plans for impvts. to water works and sewer system. W. E. Moore, Engr., 1006 Oil Exch. Bldg., Okla. City.

**Okla., Tulsa**—City plans election to vote on $5,000,000 bonds to construct water supply system from Spavinaw Creek to Tulsa. H. A. Pressey, City Consult. Engr.

**R. I., Woonsocket**—Council considering appropriating $15,400 for constructing surface water drain in the First ward in Logee street—Front St. to Grand, in Grand—Logee to Hill.

**S. C., Greenville**—Water Comn. plans improvement of service as soon as possible. Substantial extensions of water mains through various sections of city planned by the Comn., will extend mains so as to cover entire city thoroughly as far as practicable.

**S. C., No. Augusta**—City will ask bids in summer for extending mains, drilling wells and 1,500,000-gal. reservoir; also installing deep well and press pumps, chlorinating apparatus and air compressor. Abt. $50,000.

**S. C., Pickens**—$40,000 bonds voted by City for water and sewer impvts. C. Smith, Mayor.

**Tex., Abilene**—Abilene Gas, Electric, Ice & Water Co., will rebuild water pumping and electric light plant, recently burned at loss of $300,000.

**Tex., Eastland**—City Commrs. contemplate constructing 1,000,000-gal. reservoir.

**Tex., New Boston**—City contemplates installing air lift pump for deep well; capy. 5,000 gals. per hour. Harvey Miller, Secy.

**Tex., San Angelo**—City Comn. will have surveys made for watersheds of So. Concho river and its tributaries, and engage engineer to select site and estimate cost of constructing water and light plant.

**Tex., Stamford**—Plans being prep. by city for water wks. impvts., to include conc. dam with turbine engines, reservoir 200 ft. wide, 10 ft. deep and one mile long. Est. cost $400,000.

**Va., Norfolk**—Director Pub. Wks. Taylor, reports that work of estimating cost of survey to be made of Burnt Mills and Lake Phillips water project, is well under way and nearing completion.

**Va., Virginia Beach**—City voted $25,000 bonds to improve water and sewer systems.

**Wash., Bellingham**—City plans to construct 5,400 ft. 16 and 24 inch c. i. water mains betw. James street and Mausoleum. About $35,000. C. M. Adams, City Engr.

**W. Va., Wheeling**—Resolution adopted, at special meeting of Martins Ferry Council, calling for bond issue in sum of $450,000 to be voted on Aug. 13, for purpose of acquiring new site, rebldg. and enlarging and otherwise improving water works system and to combine water works and electric light plant.

**Wis., Durand**—Plans being prepared for constr. of sewer system and extension to water works system for city. Druar & Smith, St. Paul, Minn., Engrs.

## BRIDGES AND BUILDINGS

**Ala., Montgomery**—Plans completed to bridge Big Swamp. County, state and Fed. money will be used. Big Swamp lies betw. Montgomery and Selma near Lowndesboro, Lowndes Co. Citizens have subscrib. funds, in addition to other funds, to make fills & build brdgs. $20,000 will be needed.

**Cal., San Jose**—County Surveyor has been instructed by Supvrs. of Santa Clara Co., to prepare plans for inter-county bridge on San Francisco road over San Francisquito creek on San Mateo county line.

**Cal., So. Pasadena**—City has refused to participate in constr. of rein. conc. bridge over Arroyo Seco at San Pasqual avenue as requested by Los Angeles. It will, however, open and improve San Pasqual avenue if bridge is built. Est. cost of bridge is $35,000.

**Cal., Yuba City**—Petition made to Co. Bd. of Supvrs. for brdg. across Sutter By-pass and rd., 8 or 9 miles through tule dist. to connect with road to city and Marysville at O'Banion Cors. Bridge will cost from $60,000 to $70,000.

**Colo., Denver**—E. E. Maloney, ch. engr., State Hwy. Comn., has completed plans for 3 steel brdgs. to be erected over Dolores river on ocean to ocean hwy. Montezuma county; brdgs. to be constructed at Stapleton, Dolores and Montelores; will be 70 ft. long and 20 ft. wide. Work will be under supervision of C. D. Roach.

**Conn., New Haven**—Dept. of Public Works will ask for $27,000 for constr. of new ornamental bridge across Mill river on Orange street.

**Conn., New Haven**—Washington street bridge will be constructed at once whether or not Orange agrees to pay its proportionate cost.

**Del., Wilmington**—Bridge Comn., created by recent session of legislature, will have charge of constr. of new half-million dollar Washington street bridge over the Brandywine. Preliminary plans for bldg. the bridge will be started almost immediately.

**Fla., Pensacola**—Escambia County Commissioners will construct 156-ft. bridge across 11-Mile creek near Klondyke; width 16 ft., will invite bids.

**Ind., Columbia City**—Nine bridges have been recommended for repairs or built by the Commrs.

**Mich., Detroit**—Preparations for constr. of city's $3,000,000 Belle Isle brdg., will be undertaken at once. Steel and conc. steel struct., 19 spans, is proposed.

**Minn., Faribault**—Rice county; survey made for bridge over Heath Creek, Forest Twp., also for bridge in Forest Twp., over Circle Lake. W. P. Chapmen, engr.; Frank M. Kauseratt, Co. Aud.

**Minn., Rochester**—City Engr. instructed to prepare plans and specfs. for two concrete brdgs.; one over Bear Crk., at 9th Ave., and 6th St., S. E.; est. cost $11,500; one over Cascade Creek on 11th Ave. N. W., at $5,000.

**N. C., Southport**—State Hwy. Comn. considering constr. of causeway from ferry on Brunswick Co. side of Cape Fear river, to cost $150,000, including brdg. over Brunswick river.

**Ohio, Akron**—Plans for new Ash street brdg. presented to Co. Commrs. by Co. Engr. Costigan. Est cost, $14,700; brdg. is to be 48 ft. long, 45 ft. wide and of reinforced conc. construction.

**Ohio, Chillicothe**—Co. Engr. Murray Anderson, submitted estimate to Co. Commissioners on cost of bldg. Woodrow bridge in Deerfield Twp., $10,809.

**Ohio, Columbus**—Harrington, Howard & Nash, Kansas City, retained by city to prepare plans for concrete bridge to take place of present steel one over Scioto river at Green Lawn Ave. Est. cost, $300,000.

**Ohio, Lima**—Allen Co. Commrs., vote to construct Metcalf and Elm street bridges; former will cost $18,000; estimate on other now being prepared.

**Pa., Pittsburgh**—Plans for new 16th St. brdg., will be ready in less than 60 days. Contract will be let without delay, as it is planned to construct the bridge with all possible speed. Est cost, $1,250,000.

**Pa., Shickshinny**—Luzerne Co. (Wilkes-Barre) having plans prep. by D. A. Keefe, engr., Main St., Athens, for reinf. conc. brdg.; 1,550 ft. long, 30 ft. wide; stone piers. About $225,000.

**Pa., Wilkes-Barre**—Luzerne Co. Commrs. announce their intention to erect new rein. steel and conc. bridge across Black Crk., near Rock Glen, to replace present structure. Bridge will cost abt. $20,000, and has been provided for in this year's budget.

**Pa., Wilkes-Barre**—By the appoint. of B. H. Davis, N. Y., as engineer, and Carrere & Hastings, N. Y., as architects, Luzerne County Commrs. are making ready for erection of bridge over Susquehanna river at Market street as a memorial to service men of the war. Est. cost about $1,700,000.

**S. C., Charleston**—Construction of three bridges across Folly River and creek being considered; bridges to connect Folly Island with James Island.

**S. C., Columbia**—Oconee county has applied through the State Hwy. Comn. for federal aid in securing brdg. over Chauga river betw. Westminster and Madison.

**Tenn., Springfield**—$500,000 voted for purpose of bldg. bridge over Cumberland river at Clarksville.

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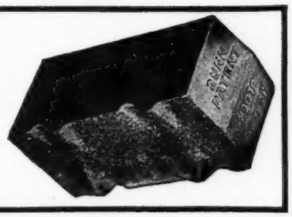

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